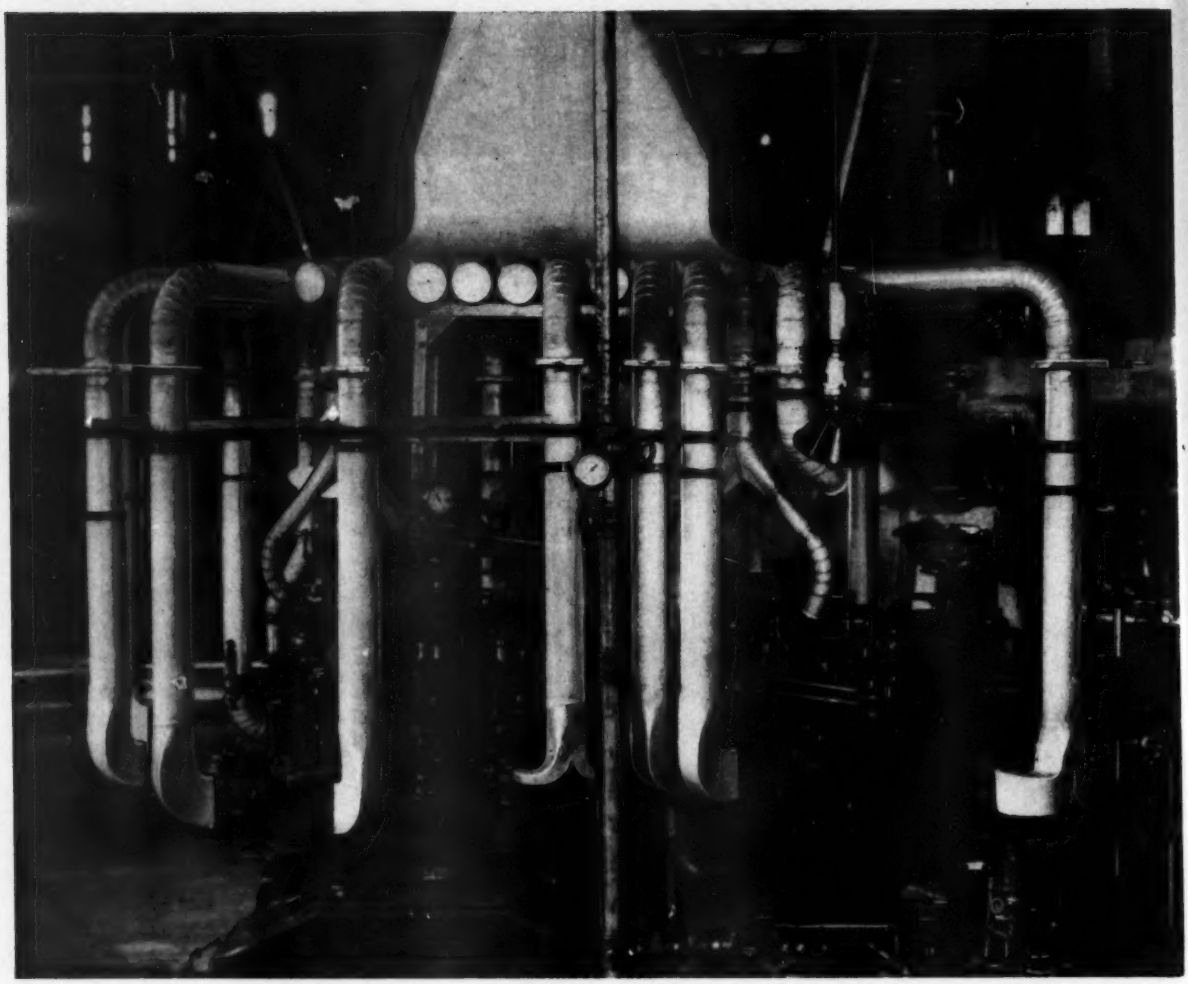
the glass industry



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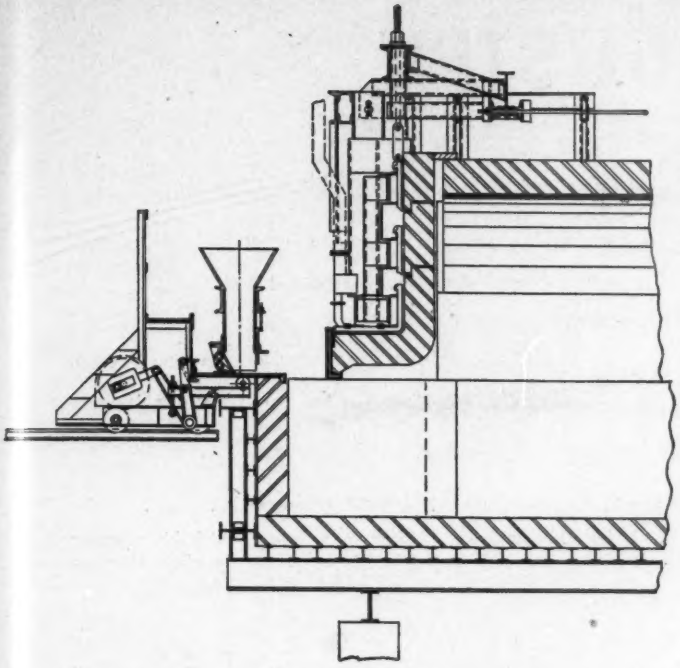

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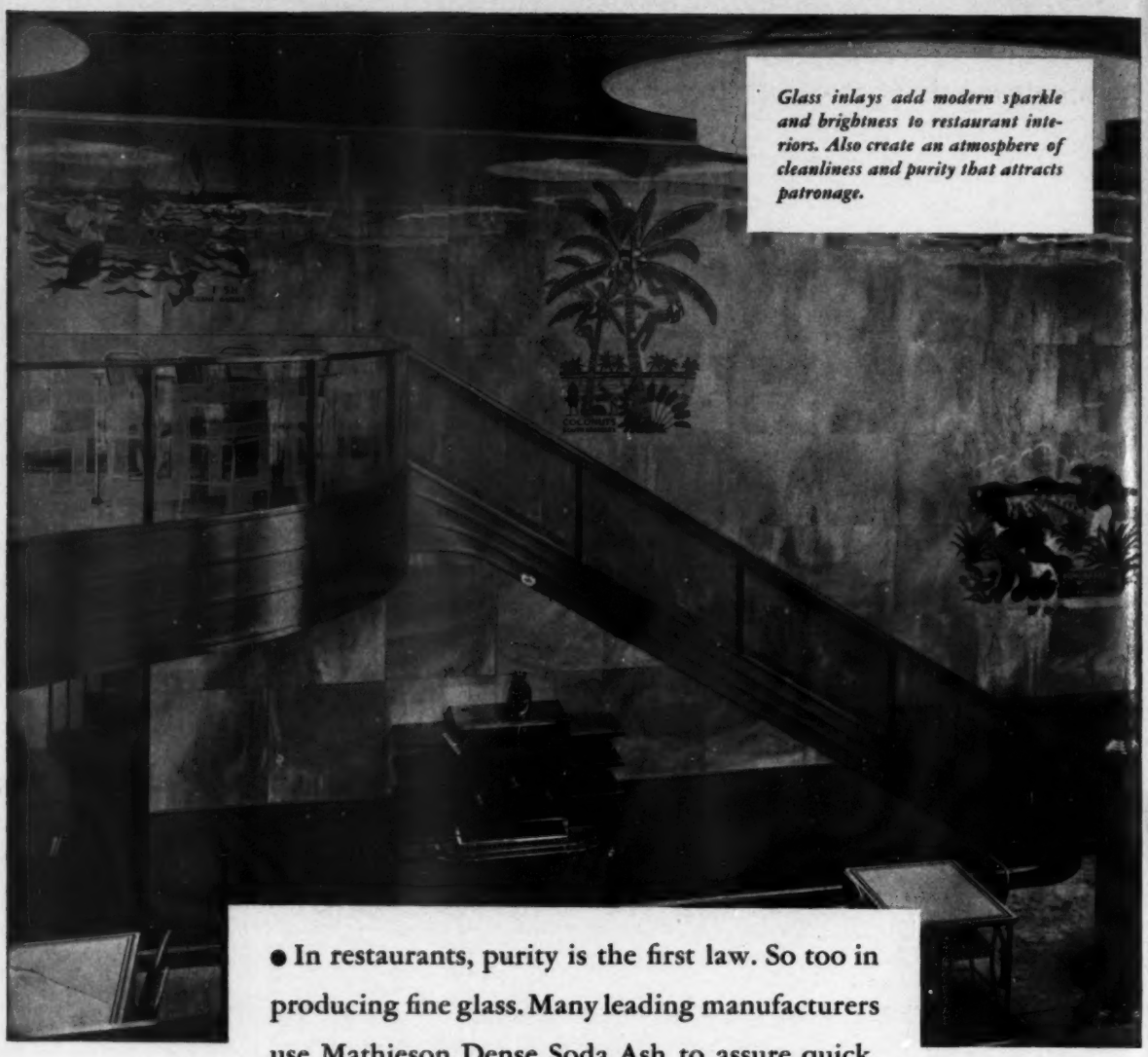

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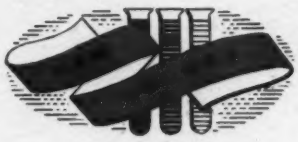

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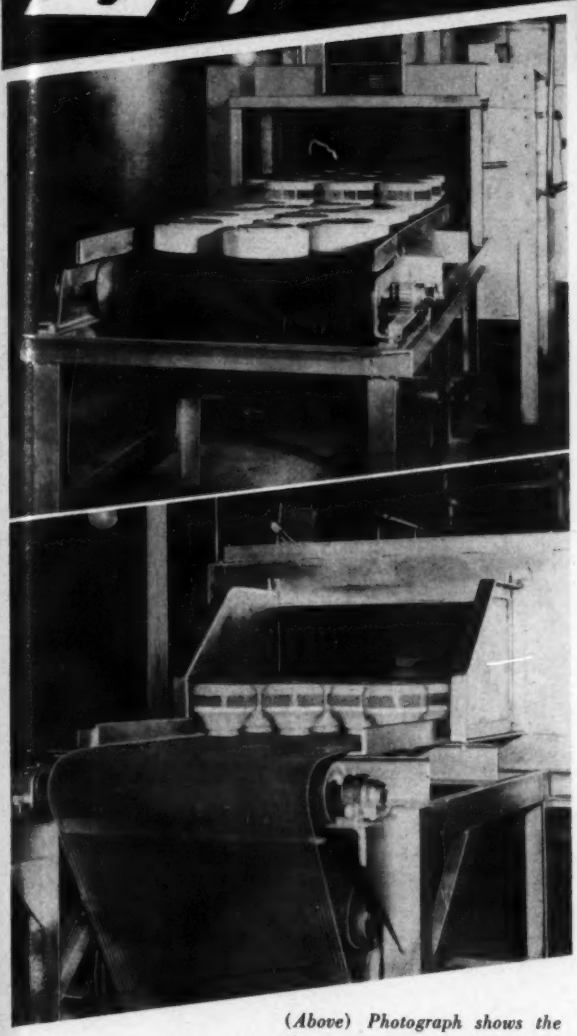

(Above) Photograph shows the charging end of a Surface Combustion Corporation Lehr in which Cambridge Balanced Belting has been used. (Below) Photograph showing the discharging end of this same new installation.

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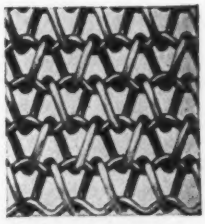

Close-up view of Balanced Mesh Belt showing the alternate spiral construction and crimped wire connection.

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HARTFORD-EMPIRE COMPANY HARTFORD CONNECTICUT

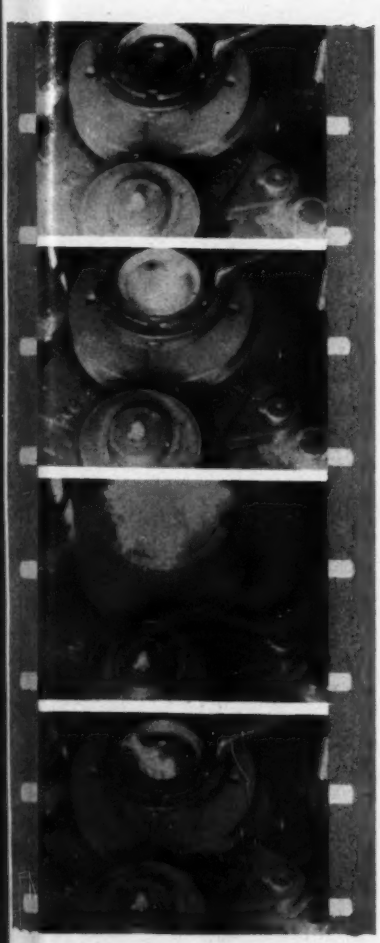
THE GLASS INDUSTRY

VOLUME 22, NUMBER 1, JANUARY, 1941

THE USE OF SLOW MOTION PHOTOGRAPHY IN IMPROVING THE GLASS MAKING PROCESS

By R. F. HATCH

Hartford-Empire Company



Frames from motion picture film showing a gob entering the blank mold. The white vapor-like cloud coming from the mold is the flash of light from oil that has dropped into the blank mold ahead of the gob and become ignited. If this occurred later, it might cause a back pressure in the mold and result in defective ware.

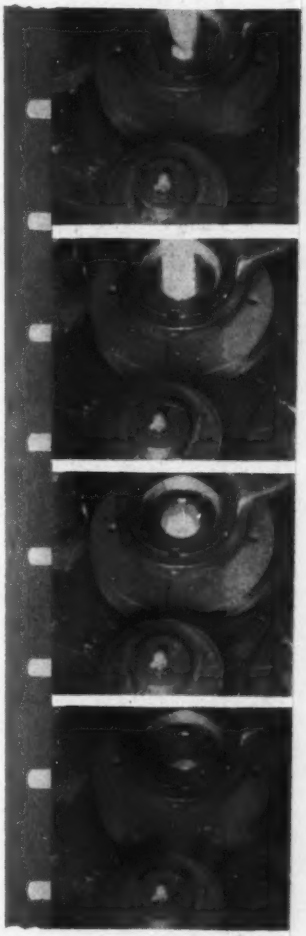
The glassman seeking to improve the quality of his ware will find that slow motion photography offers a new approach to the problem, yielding remarkable results. Though the fact is often lost sight of, glass forming machinery moves too rapidly for the eye to follow, but this speed can be reduced by the camera to a point where careful and deliberate observations become a simple matter. Faulty adjustments and imperfect timings are not only uncovered but their effect upon the finished ware made predictable by the experienced eye.

The Hartford-Empire Company has used slow motion photography for a number of years and has developed it as an effective instrument in the design and improvement of glass making machinery. In this article, the Company describes in detail the technique involved.

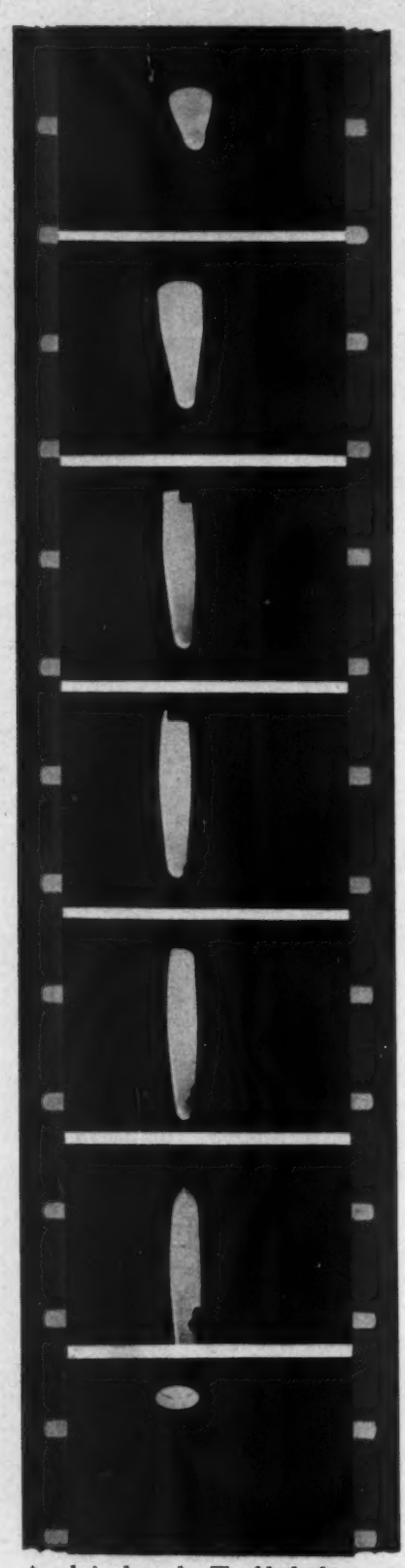
The object of slow motion movies is to slow down motions which occur at such a high speed that they cannot be observed by the eye. Silent 16 millimeter moving pictures are taken at the normal rate of 16 frames or pictures per second. The picture is projected at the same rate, so that the projected motion occurs in exactly the same time as in the event which was photographed. The speed of projection cannot be slowed down enough to give any appreciable slowing of the action.

In order to obtain a slow motion effect the pictures are taken at a faster rate but projected at the normal rate of 16 per second. Some amateur moving picture cameras can be adjusted to take pictures at the rate of 64 frames per second. When pictures are taken at this rate and projected at 16 frames per second, it takes four minutes to project a scene which was taken in one minute.

This speed reduction is not sufficient for a careful analysis of the movements of glass making machinery. One reason for this is that the exposure time is too long. An ordinary amateur camera has a normal exposure of about 1/40 of a second. When the camera is operated at 64 frames per second the exposure becomes about 1/160 of a second. A projected scene will appear slowed down and perfectly natural to the eye but, if the projector is stopped to permit examination of a still, it will be found that any fast moving part is considerably blurred.



This picture on the right is a c of the one on the left. All this page were taken at a ca of 128 frames per second. frames omitted between each ing top to bottom and left to 7, 5, 1, 1, and 10.



A gob is sheared. The black that encroaches upon the gob at its top is the shearing mechanism. The black overlapping the bottom right is an obstruction between the gob and the camera. Speed 128 frames per second. No light except from the molten glass.

Very satisfactory results are obtained, however, with a camera operating at 128 frames per second. This slows down the motion eight times; an event occurring in one second will take eight seconds on the screen. In the same way, pictures taken at 1000 per second slow the motion down about 62 times; an event occurring in one second will take over a minute when projected.

A common misunderstanding is due to confusing slow motion photography with high speed photography. Slow motion photography has been explained. High speed photography, in the modern use of the word, usually refers to the work done by Dr. Harold E. Edgerton of the Massachusetts Institute of Technology. His pictures may be movies or stills and are distinguished by the fact that the exposure is determined by the duration of a flash of light which may be less than five one-millionth of a second. By the use of his equipment he has taken pictures so quickly that he can get a sharp photograph of a rifle ball leaving the muzzle of a rifle, and other equally surprising results. Such extreme speed is not necessary in the study of ordinary glass manufacturing. Slow motion photography requires that the pictures be taken in rapid succession to permit minimum amount of motion between frames. High speed photography is generally understood to mean the taking of a picture or a series of pictures, with an extremely brief exposure, and, when applied to moving pictures, likewise presupposes rapid succession of the separate frames.

Slow motion photography has been used by the Hartford-Empire Company for a number of years both in its own plant and in the plants of its licensees. It is useful in connection with the development and design of novel equipment. There are a great many movements in bottle making machinery which occur so rapidly that to the naked eye nothing can be seen except what appears to be an instantaneous movement. When the Hartford-Empire Company first builds a new device, it often takes slow motion pictures in order to study the movements. The cushioning of air cylinders requires delicate adjustment. If there is not sufficient cushioning this can be readily detected by the noise from the impact. On the other hand, if there is too much or uneven cushioning this cannot be observed by the eye and can only be guessed at by the injurious results in the ware being made. Using pictures taken at 128 or 1000 frames per second, the movement of the fastest air cylinder used in glass manufacturing can be analyzed in detail. In one instance it was found that what appeared to be an extremely smooth and rapid action of high speed pneumatically actuated glass shears was really a fast movement followed by a repeated slowing up or chattering of the shears at the time they were cutting through the glass. After repeated adjustments and experiments this condition was overcome until a perfectly smooth, extremely rapid shearing action was secured.

In the same way, a study can be made of the movement of bottom plates, blow heads, inverts and other fast moving parts. To the naked eye a blow head may appear to have a very smooth motion and to seat quickly and firmly on the mold. Slow motion photography sometimes shows a series of rebounds when the blow head hits the mold. This results in non-uniform ware, loss of air, unnecessary wear on the parts, and slows up production.

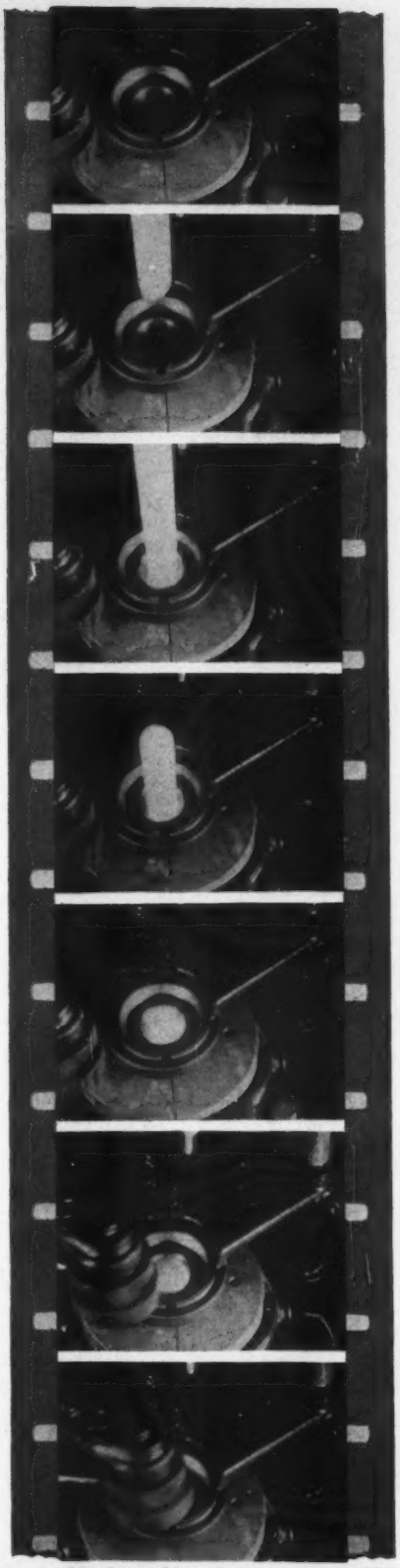
One very valuable use of slow motion photography is the study of gob shapes as they are received in the mold. To the naked eye the gob, as it passes into the mold several feet below the orifice, appears to be simply a streak of light and no shape can be observed. A gob delivered to a standard I. S. Machine from a 12-foot metal line is travelling at a speed of 22 feet per second, just before it reaches the mold. With a normal speed moving picture camera operating at 16 frames per second and with an exposure of about 1/40 of a second, the gob would travel about 6½ inches during each exposure. When projected on the screen, as a movie, this would look perfectly natural, but if the projector is stopped to show an individual frame, the picture of the gob will be very much blurred at the top and bottom, its shape distorted, and apparently elongated, perhaps twice as long as it really is.

If the pictures are taken at a speed of 128 per second and 1/216 of a second exposure, the result will be improved, but during each exposure the gob will have travelled more than an inch. This still gives a blur on both ends of the gob and an apparent elongation. Also, if the gob is other than cylindrical, its shape is distorted on the screen.

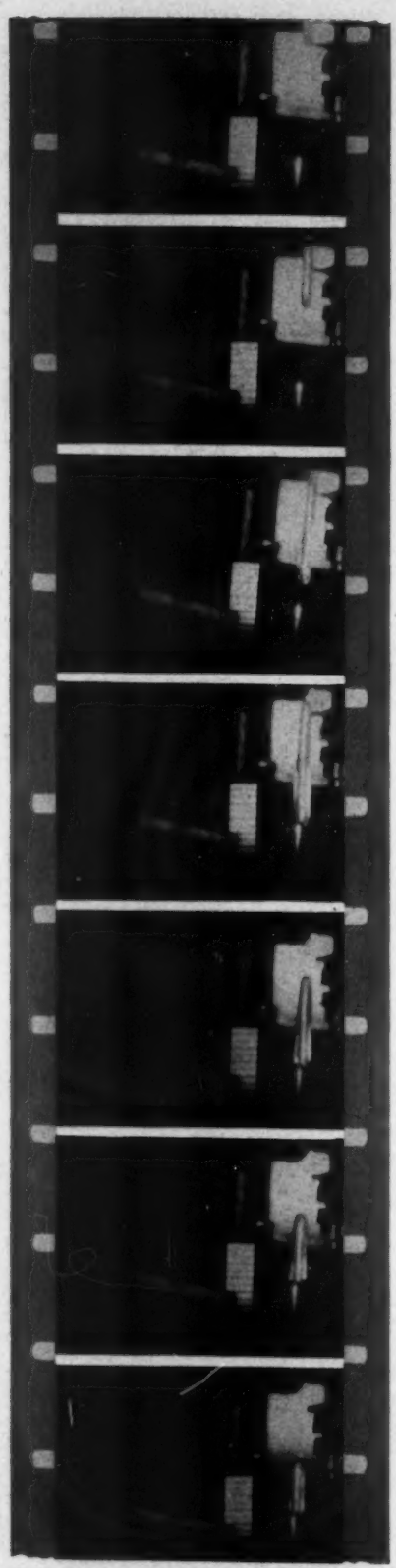
It has been found quite satisfactory to use a camera taking these gob pictures at the rate of 128 frames a second and with 1/1000 of a second exposure. In 1/1000 of a second the gob will have travelled about ¼ of an inch. As these pictures are always taken at a distance of at least two or three feet, the angular displacement of the gob during exposure is very slight. A still projection of one of these frames shows practically no blurring whatever and a good clear outline of the gob is secured. Shear scars can be seen if they are positioned so as to appear in silhouette.

A satisfactory camera for general glass factory use is a 16 millimeter Bell & Howell Filmo 70-B Super Speed camera, which is built to take pictures at 128 frames per second and at no other speed. It is believed that this camera operates at a higher speed than any other using a mechanical shutter. This camera is normally equipped for 1/216 of a second exposure, but it can be set by the manufacturer for any desired exposure. As previously stated, 1/1000 of a second exposure has been found to be very satisfactory. This camera is convenient for factory use. It is spring driven and, therefore, does not require wiring connections. It is small and compact and can be used in many situations where it would be impossible to use the larger camera operating at higher speeds.

In photographing gob shapes as received in the mold, it is often impossible to get more than one gob in each shot. Where the event to be photographed has a cycle occurring not more often than once in four seconds, the starting of the camera must be timed by some preceding event. For example, if the gob is to be photographed as it enters the mold, it may be possible to watch the shears and to start the camera in operation at the instant the shears cut. While the Bell & Howell camera appears to pick up its speed almost instantaneously, it is always desirable to allow the film to run for a second before the event occurs. In photographing the application of a blow head to the mold, the camera can be timed from the closing of the mold. Careful observation is required



Gob entering a blank mold. Camera speed 128 frames per second. Artificial light. Notice how clearly defined is the shape of the gob, also the lack of distortion, a result that is possible to attain only by a method such as is described here.



5 frames omitted.

9 frames omitted.

13 frames omitted.

23 frames omitted.

21 frames omitted.

14 frames omitted.

Gob entering the blank mold. The white square in the background is a carbon arc light to indicate time in 1/120 seconds. The scale is to permit measurements. Camera speed 1000 frames per second.

to insure not missing the desired event. The pictures are taken "on the wing," so to speak, and, as with a baseball bat, you must be sure you are swinging when the ball goes by.

The camera which Hartford-Empire Company has used for speeds of 1000 per second was known as the Eastman High Speed Camera, Type 2. This camera is no longer offered for sale. After some years of experience it has been found that pictures at this speed are seldom necessary. A speed of 128 frames per second will fill 95 per cent of all factory requirements. The higher speed camera is electrically driven and quite heavy. A very rigid tripod has to be used and it is impossible to use this camera in many places where a smaller spring driven camera is readily set up.

The Bell & Howell camera is economical in the use of film. It will run for about five seconds for each winding of the spring and will expose about 16 feet of film. The camera can be used either with 50-foot or 100-foot spools. On a 50-foot roll you can usually get at least three scenes, and sometimes as many as ten. The camera can be started and stopped as desired, so the number of scenes which can be taken on a film depends only on the duration of the event being photographed. Of course, an allowance has to be made for waste, due to the necessity of starting the camera before the event occurs.

The Eastman camera working at 1000 frames per second has a rotating prism which acts as a shutter, and the film moves continuously. The camera cannot be stopped until after the entire film has been exposed. Therefore, in photographing mold charges, for instance. it is necessary to use a full length of film (at least 50 feet) for each gob, whereas on the Bell & Howell camera sometimes 8 or 10 different gobs can be photographed on a single 50-foot roll.

The complete equipment for taking pictures at 128 per second is readily portable and with the exception of the lights, not bulky. A fairly rigid tripod having a tilting head should be used whenever possible. Owing to the high speed of the camera, however, it is possible to use it without a tripod, without any serious ill effects. In this way pictures can be taken looking nearly straight down into an I.S. mold from position completely inaccessible to many other cameras.

It is desirable to use as fast a lens as possible and and f:0.99 lens is generally used, but with the modern high speed films, such as Eastman Super XX or SSS Agfa, the lens can usually be shut down to f:1.5 or smaller. It is believed that an f:1.5 lens is fast enough for most purposes. A telephoto lens is of no practical value because the situations usually found are too congested to allow enough lights to be brought to the scene.

Lighting equipment is a serious problem. For Hartford-Empire Company use, it was necessary to have something readily portable from one factory to another. For this purpose the best that could be found was the No. 4 photoflood lamp mounted in a first class tripod reflector. Three No. 4 photofloods in reflectors and placed within three of four feet of the object to be photographed are quite satisfactory. The lighting conditions in most factories are the worst that can be imagined for photography. The object to be photographed is often surrounded by air pipes and moving parts. The air inside the glass

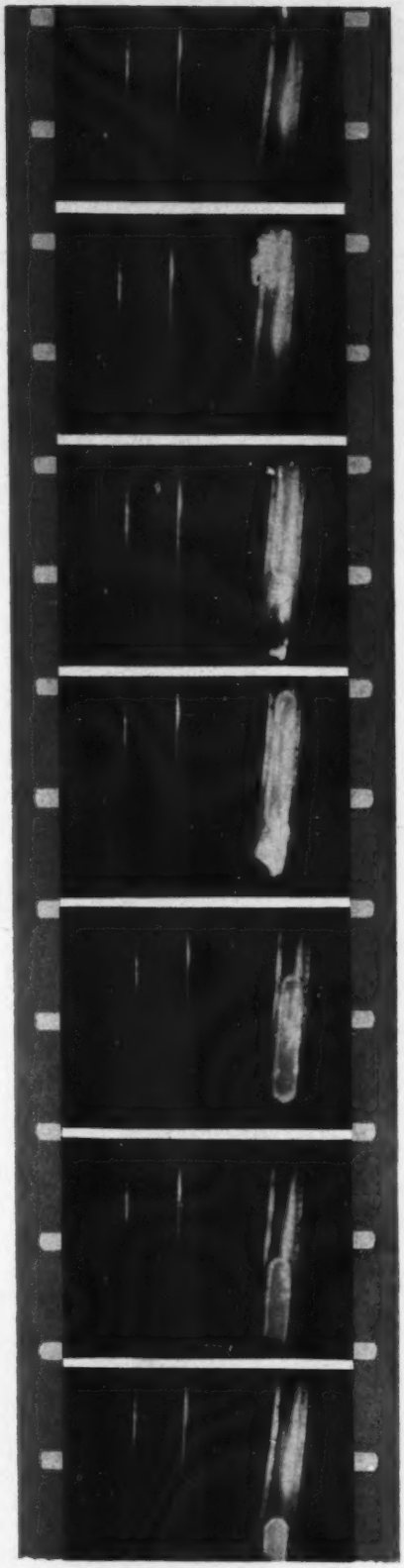
forming machines is usually full of smoke, steam and oil spray. The only safe rule is to use as many No. 4 photofloods as you can, as near as possible to the object. This will never give so much light but that the camera can be adjusted to take care of it. The use of an exposure meter is highly recommended. It is possible to get satisfactory pictures with only two photofloods two or three feet distant from the object. It should be understood that many of these pictures will not be good as expert photography, but they are good enough to show the motions desired. If the important parts can be painted a light color, much better results will be obtained, especially if the light is limited. If equipment is to be used in one plant only, spotlights of the type used by professional moving picture photographers would be of great advantage.

Molten glass furnishes enough light to photograph itself; therefore, if the shape of a gob or other hot glass is all that is desired, this can be taken without any outside light. All that will be seen will be a white silhouette on a black background, which is sufficient in many cases.

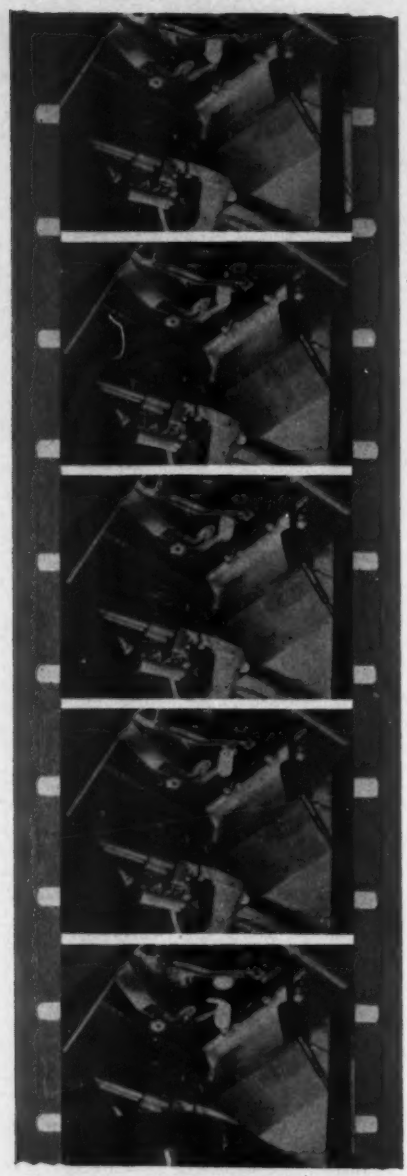
Even small amounts of dirt and smoke form a serious obstacle to the use of the camera when placed in close proximity to glass forming machines. To change the film the camera should always be taken to some clean place where there is no dust. The lens cap should be removed from the camera only while the picture is being taken. If the lens cap is not removed, the picture will not be a success. The author has proved this by experience.

Any good 16 millimeter projector can be used for studying slow motion films. The projector should be capable of being run backwards and of being stopped for examination of single pictures as long as may be desired without overheating the film. Practically all modern high grade projectors will do this. A very useful attachment for a projector is a frame counter which indicates the number of frames from one event to another. While the nominal speed of the camera is 128 frames per second, this speed is not exact. The camera tends to speed up a little with use. However, it is usually the relative times which are of interest, the number of frames in one event can be compared with the number of frames in another event with very close accuracy.

If it is desired to obtain the exact time occupied in high speed movements, some form of indicating device must be employed. The most convenient device for this purpose is a small Neon glow lamp made by the General Electric Vapor Lamp Company. If this is placed in the field, the halves will light alternately at the rate of 120 per second. This speed does not coincide exactly with the rate of exposure of 128 per second, with the result that for some distance a flash will be recorded in each frame and then for a short space the flash will occur while the shutter is closed. This does not form a serious difficulty, however, as a sufficient number of flashes will be recorded to ascertain the exact rate of exposure. If it is found that the camera happens to be operating at 130 frames per second this figure can be used where the flash fails to record. A carbon electrode arc light can be used for the same purpose, but it is much less convenient. When taking pictures at 1000 per second, successive flashes on the Neon glow lamp will take about



Gob passing through a deflector. Notice the flame due to the combustion of light oil used on the delivery system. Camera speed 1000 frames per second. Artificial light.



3 frames omitted.

4 frames omitted.

2 frames omitted.

5 frames omitted.

A gob just after shearing, camera speed 128 frames per second, photo flood lights.

A few of the uses of slow motion photography in connection with research and development and factory operation have been mentioned. It has been found that slow motion photography is very useful in training plant employees. Men who specialize in and "live with" one particular machine acquire a keenness of perception regarding the operation of that machine obtained only by long study of split-second motions. Slow motion pictures are the only means for reconciling the differences of individual observations, many of which are often nothing but guesses. These pictures also serve to present both proper operation and improper operation to supervisors and maintenance men in the glass factories and to machine designers and engineers. Nothing except the bottles themselves has so clearly shown the benefits of an improved device or of the ill effects of faulty adjustments, as slow motion movies. There are many instances where an operator may be told to make a certain adjustment under certain conditions. This adjustment may produce no results visible to the naked eye. Slow motion pictures make it possible to show the operator just what is happening with improper adjustment and the beneficial result secured from proper adjustment. Visual education of this kind is far more effective than lengthy discussions and typewritten pages.

Records should be kept of all film for future identification. The box on the right is adapted from a typical "report" card used by Hartford-Empire Co.

eight frames, so that the speed of any motion can be ascertained with great accuracy. For most purposes, the nominal camera speed of 128 frames per second is so close that the speed can be determined with sufficient accuracy simply by counting the number of frames.

A combined film viewer and splicer is very useful and it will many times take the place of a projector. Of course, it is much quicker and more convenient to use the film viewer where a small projected picture is all that needs to be studied. As for a screen, any white surface may be used, but it is a good investment to buy a first class one, not less than 36" wide.

To: John Doe

From: Richard Rowe

Subject: Slow Motion Pictures of Gob Delivery at Blank Glass Company

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On October 12, 1940, I visited Blank Glass Company. The purpose of this visit was to take moving pictures of the shearing and delivery of gobs.

Feeder set-up cards and samples of the jobs photographed may be seen in the Feeder Department.

A 15¾ ounce weight rectangular flask was running on Shop 12 at 25 per minute. Optical tank nose temperature, 2317°F. For feeder set-up cards and samples see Mr. Doe. This job was photographed as follows:

Scene No. 1—128 per second. Shearing and delivery to scoop.

Scene No. 2—1000 per second. Gob going down trough.

Scene No. 3—128 per second. Gob in deflector.

TESTING THE CHEMICAL RESISTANCY OF AMPOULES

By DR. OSCAR KNAPP
Upjest, Hungary

Cooperation of glass technologists in different countries through the International Commission of Glass Technology has been, of necessity, practically at a standstill since hostilities broke out in Europe. We are especially pleased, therefore, to have this opportunity of furthering international cooperation under present distressing circumstances by publishing Dr. Knapp's paper on chemical durability—selected by American glass technologists for international cooperation work.

We hope that Dr. Knapp will continue this work and that he will report later on results obtained by his proposed method.—The Editor.

Ampoules made of glass tubing are used for the storage of pharmaceutical solutions and of substances for medicinal injection. These glasses have to meet very stringent chemical requirements to insure a minimum of solvent action between the glass container and its contents. Among the chemical components of ampoule glass there are always present sodium and potassium oxide. If water or aqueous solutions are stored in alkali-containing glasses, some part of the alkali tends to dissolve out of the glass.

If excessive amounts of alkalies are extracted from glasses containing medicinal solutions, they may cause disagreeable and dangerous changes in the contents. Solutions of alkaloids are especially sensitive to alkali. The chlorhydrate compositions of the alkaloids are easily soluble in water; the free alkaloid bases, on the contrary, are difficulty soluble, or even insoluble, in water. Thus, the alkalies dissolved from the glass surface decompose the chlorhydrates thus liberating the bases. In the case of storing aqueous solutions of alkali-sensitive compounds, e.g. solutions of apomorphine, atropine, adrenaline, morphine muriate, narcotine hydrochloride, strychnine nitrate, sublimate, etc., only such glass should be used which yield a minimum of extractable alkali and which therefore cannot cause any decomposition, crystallization or turbidity of their contents. In such cases where extracted alkali has resulted in chemical changes of contents, precise dosing, which is so important in medical manipulation, is impossible. Under these conditions, the injection needle sometimes actually withdraws a solution lower than the specified concentration, but it also happens, however, that it sucks up solid, poisonous, sharp-edged alkaloid crystals, which cause strong and undesired local stimulating effects in the blood vessel. As Grübler[1] stated, the physician in such cases gives more medicament than is wanted.

According to Tilmans and Mildner[2] one of the troubles encountered in the making of salvarsan solutions originates from the extracted alkali silicates. Weiner[3] emphasized that the alkalies yielded by the glass have a very important influence in salvarsan therapy. According to Matzenauer[3] the unfortunate phenomenon which occurred in the beginning of the salvarsan development and which caused some cases of death were due to alkalies dissolved from glass. It is therefore of the utmost importance to store injection liquids only in glass containers from which alkalies are not extracted.

The amount of alkalies extracted depends, obviously, in the first instance on the chemical composition of the glass. However, the decomposition of the glass surface is affected by temperature; the attack is accelerated as the temperature rises. Since solutions stored in ampoules are generally sterilized at 100-130°C, ampoule glasses should not yield alkalies even at these high temperatures.

Though the importance of high chemical durability of glasses for ampoules is recognized in every country in which ampoules are used, we have no standardized international test at present according to which ampoule glass can be evaluated, accepted or rejected. The formulation of such an international test is very important, because the relatively few glass works which melt and draw ampoule glass, not alone supply their products to their own country but ship it all over the world.* Thus, the products of the same glass works are probably evaluated in different countries by different tests.

In the following we describe briefly the tests for ampoule glass which are specified in different countries:

A. The national Formulary of the U.S.A. IX Revision. Dissolve 0.005 g. phenolphtalein in 0.5 ml. neutral alcohol and mix this solution with 1000 ml. distilled water. The ampoules are filled with this solution, sealed by means of a blow pipe and immersed in boiling water for six hours. The contents of the ampoule should not show a pink color after cooling and no loose scales or flakes should originate from the glass.

B. The Proposal of the British Pharmacopoeia.

1. Test on whole ampoules. Fill the ampoules to their prescribed capacity with acid solution of methyl red, seal them by means of a blow pipe and heat in steam at a pressure of 15 lbs. per square inch for half an hour. Cool and examine the color of the solution. The glass passes the test if the color of the test solution has not changed from pink to the full yellow color of methyl red, as indicated by comparing it with that of a solution, prepared by adding 0.1 ml. of N/10 sodium hydroxide to 10 ml. of the acid solution of methyl red. The test is carried out not more than fourteen days before the ampoules are to be used.

2. Test to be applied to glass when crushed. A test solution, consisting of 100 ml. of water, 0.4 ml. of N/100 hydrochloric acid and 0.4 ml. of strong solution of methyl red is boiled and, while boiling, transferred to a conical flask of resistant glass of 250 ml. capacity. The flask is fitted with a reflux condenser or with a suitable condensing apparatus, made of resistant glass. The flask is quickly placed in a bath of boiling water, so that the contained solution is below the level of the water in the bath. Boiling is continued for one hour. At the end of this time the color of the solution is observed. If any color change has taken place, the flask and the condenser are unsuitable for use. The glass is crushed and sieved; particles which pass through a No. 25 sieve but fail to pass through a No. 36 sieve are used for the test. One-half gm. of the sieved glass is washed free from dust in a small conical flask by repeated washing with alcohol

*Note by Editor: While this is the situation in normal times, it probably does not apply to current conditions.

(95 per cent) and is dried at 100°C. The sieved glass is placed with 100 ml. of a fresh portion of the test solution into the conical flask and the test is repeated, but the boiling is continued for half an hour instead of an hour. The glass passes the test if, at the end of this time, the color of the test solution has not changed from pink to the full yellow color of methyl red as indicated by comparing it with that of a solution prepared by adding 0.1 ml. of N/10 sodium hydroxide to 10 ml. of the test solution. The acid solution of methyl red is prepared by mixing a strong solution of methyl red with 8.3 ml. of N/50 hydrochloric acid and a sufficient quantity of water to produce 1000 ml. The strong solution of methyl red is prepared by dissolving 0.04 gm. of methyl red in 50 ml. of alcohol (95 per cent), adding 1.5 ml. of N/20 sodium hydroxide or a quantity sufficient to ensure that the color of the solution corresponds to about pH 5.2 and diluting to 100 ml. with water.

C. The German Pharmakopoeia, VI Edition, Supplement Order of 2.7.1931. The ampoules to be tested are ground and freed from the fine sizes by sieving on No. 5 sieve (approximately 0.3 mm.) 0.5 gm. of the coarse powder are put in a flask of Jena glass, which was previously boiled out with distilled water. The glass is then freed from the last adhering dust by repeated washing with distilled water or alcohol. The glass is then boiled in water for half an hour with 100 ml. of distilled water, 0.4 ml. of N/100 hydrochloric acid and one or two drops of methyl red solution. After this period the red color of the solution should not have completely disappeared.

D. The Italian Pharmacopoeia, V. Edition. A few ampoules are filled with 1 per cent morphine hydrochloride solution or 5 per cent strychnine nitrate solution or 1 per cent sublimate solution or distilled water in which alcoholic phenolphtalein of 1 per cent is dissolved. The ampoules are then sealed and heated in an autoclave at a temperature of 112°C for half an hour. If the glass is neutral, the liquid shall suffer no change; the solution of morphine or of phenolphtalein shall show no color, the solution of sublimate and of the strychnine nitrate salt, no precipitation or turbidity.

E. The Roumanian Pharmacopoeia, Edition IX specifies the same tests as the Italian.

F. The Spanish Pharmacopoeia, VIII Edition. Fill the ampoules with distilled water and boil them for one or two minutes. Pour out the contents; fill with freshly distilled water; and heat for one hour at 120°C in an autoclave. One hundred ml. of the cooled contents are titrated with N/100 hydrochloric acid, in the presence of 6-8 drops of saturated sodium sulpho-alizarine, to a faint leather color. Good glasses require 1-5 ml. For practical use, however, it is enough to fill the ampoules with a 2 per cent solution of morphine or of 0.5 per cent strychnine solution or of sublimate solution of 1 per cent, to boil them for half an hour at 112°C. The solution of morphine should not change its color to brown, the sublimate not to yellow and the strychnine should not precipitate crystals.

G. The Belgian Pharmacopoeia. Place 5 gm. of the coarse crushed ampoules in a flask of resistant glass, cover them with 100 ml. distilled water, 0.5 ml. N/100 hydrochloric acid and two drops of methyl red. Heat the flask in boiling water for an hour. During this time the red color of the solution should not have changed.

H. The Swiss Pharmacopoeia. Calculate the inner surface of the ampoule and then wash with distilled water. For every 100 sq. cm. of calculated surface add 0.2 ml. of N/100 hydrochloric acid. The ampoule is then filled with freshly boiled warm distilled water, which contains 10 drops methyl red in 100 ml and enough N/100 hydrochloric acid to make it "methyl red neutral." The ampouls is then closed and warmed at 80°C for half an hour. During this time the red color should not entirely disappear.

I. The Norwegian Pharmacopoeia. The ampoules are filled with freshly boiled cold water containing 3 ml. of N/10 hydrochloric acid and 4 ml. of phenolthalein solution per liter. Heat the ampoules in a water bath for half an hour. The color of the liquid should not change to red. After cooling, add brom thymol blue solution. The solution should have a yellow color corresponding to pH 6.2.

The tests specified by the various countries may be divided into two groups: The first group consists of tests which measure the chemical durability of whole ampoules. The tests of the second group measure the durability of the crushed ampoules. To evaluate each type of test let us describe their respective advantages and disadvantages.

The advantages of testing whole ampoules are: (1) The tests are rather simple; (2) They do not require complicated apparatus and chemical skill is unnecessary. The disadvantages may be summarized as follows:

1. There is no constant relation between the inner surface and the cubic content of ampoules of different sizes. Thus, the relative action of the test solution is not the same in the case of small and large size ampoules. The following table shows the variation of inner surface area per 1 ml. ampoule capacity for ampoules of different sizes.

Size	*Inner surface*	*Inner surface per cubic content*
1 ml	6.03 sq cm	6.03
2 "	9.43 "	4.22
3 "	12.27 "	4.09
5 "	18.50 "	3.70
10 "	26.64 "	2.66
20 "	46.50 "	2.33
25 "	53.40 "	2.14
50 "	90.67 "	1.81
100 "	143.57 "	1.44

W. Bruckhausen[4] observed that the methyl red solution grew pale in different times in ampoules produced at the same time but of different size. He established that ampoules of large size yield less alkalies per unit of capacity than ampoules of small size. G. Dultz[5] proposed to test ampoules of different size with solutions of different concentration. To get correct and comparable results he suggests the use of the solutions given below for ampoules of the corresponding size.

Size	*ml N/100 HCL per litre*
1 ml	3.0
2 "	2.3
3 "	2.1
5 "	1.9
10 "	1.4
20 "	1.2
25 "	1.1
50 "	1.0
100 "	0.8

2. The quality of the inner surface of the ampoules is unstable and depends on the annealing conditions. It is a general rule that the better the annealing of the glasses

the lower is their chemical resistance. This may be seen in the following table.

Soluble annealed	*unannealed*	*Difference*	*According to*
0.11	0.024	87	Gehloff and Schmidt[6]
0.463	0.029	94	Keppeler and Körner[7]
1.31	0.11	92	Rexer[8]

3. It is impossible to test small size ampoules by inner surface extraction as W. Tepohl[9] pointed out; the permitted quantity of alkalies extracted from the glass is smaller than the source of error of the tests. For making ampoules, the only suitable glasses are those which belong to the first and second class, acording to Mylius. Thus, the alkali given off from the 100 sq. cm. surface can be only 0.15 milligram when heating at 100°C or 0.045 mg. when heating at 80°C for three hours and less, if the heat treatment is only one hour or half an hour. Small size ampoules have 6-20 sq. cm. inner surface and the alkali permitted by extraction is therefore only 0.009-0.03 mgr. by treatment at 100°C or 0.0027-0.009 mgr. by treatment at 80°C. These quantities are so small as to make difficult their determination.

4. In the testing of the inner surface it is necessary to consider the sensitivity of the indicators. According to H. Bodendorf[10] phenolphtalein is unsuitable as an indicator for the small concentrations of alkali released by ampoules. The conversion of phenolphtalein from the lactoid form into the chinoid form takes place only at rather high OH'ion concentrations. The carbon dioxide of the air has a disturbing effect; it is 20 times stronger than phenolphtalein and forms alkali carbonates in part, against which phenolphtalein reacts rather poorly. Phenolphtalein is suitable only in cases of alkali concentrations, corresponding to glass belonging to the IV class, according to Mylius. It is therefore useless for ampoules. As Fischer and Horckheimer[11] stated, bromthymole blue is not sufficiently sensitive for use with N/100 solutions. They filled glasses with distilled water, heated them in steam and determined the pH value of their contents, and the color obtained by adding some drops of bromthymol blue. They found that the tint of bromthymol blue was the same in the presence of 0.9 ml. N/100 hydrochloric acid as in the presence of less than 0.4 ml. acid of the same concentration. Among the various indicators the sensitivity of methyl red is the greatest, its color is pink at pH 6.4 and yellow at pH 6.7.

5. In tests which call for the use of alkaloid solutions, only some of the alkaloids have the necessary sensitivity. Thus J. Vintilescu, C. N. Jonescu and A. Kyzik[12] established that morphine chlorhydrate is unsuitable for test solutions, because its color fades in alkali-free glass or even in silica glass due to a reaction with the oxygen of the air resulting in oxymorphine chlorhydrate. This reaction is accelerated by a small amount of alkali. Strychnine nitrate solution is sensible only to a small degree. The sensibility of the sublimate solution demands, that the pH of the solution shall be 8.2 at least. The alkali content of such solutions is, however, above the limit permitted for ampoules.

The grain tests are free from the drawbacks given above; their results being independent of the original surface area and volume of the glass container. The surface area of 5 gm. of grains made according to the German or Belgian Pharmakopoeia is about 600 sq. cm.[13] and made according to the British proposal is more than 600 sq. cm., which is much greater than the inner surface of a 100 ml. ampoule. The sensitivity of methyl red is satisfactory for grain tests. The results from duplicate tests agree within ± 5 per cent. O. G. Burch[14] also prefers to test grains, because the results are independent of the size, form, annealing and storage of the ampoules, and because the accuracy is very high due to the relatively large quantity of alkali dissolved.

Tests of crushed grain generally are somewhat complicated, require special apparatus and call for some skill in manipulation. However, the results are reliable when all details of the procedure are given careful attention. The necessary details are discussed in the following numbered paragraphs.

1. The distilled water used in the test should be carefully prepared and should be neutral to methyl red. It is advisable to prepare a color standard for comparison of end points. This may be done by adding some of the test solution to a flask of the same size and shape as that used in the test and then titrating the contents to the desired end-point color.

2. The flasks used in the test must be tested by running a blank determination. Alkali extracted from the flasks must be determined so that the regular test results can be corrected.

3. Both the upper and lower limits of grain sizes should be defined. Narrow limits insure nearly equal surface areas for the grains.

4. The results should be determined quantitatively by titration of the excess of acid remaining at the completion of the test.

5. The fine dust adhering to the surfaces of crushed grains must be entirely removed to insure reliable results.

If we judge the tests prescribed in the various countries according to the views given above, we can establish the following conclusions:

The tests of the U.S.A., of Britain (for whole ampoules), of Italy, of Roumania, of Spain and of Switzerland measure the chemical durability of the inner surface of ampoules and are therefore according to the reasons mentioned unsuitable.

The tests of Germany and of Belgium call for crushed ampoules. They do not state, however, the upper limit of the grain size, the use of distilled water neutral to methyl red, and give only qualitative values. The test of Britain for crushed ampoules does not yield quantitative results, and the permitted alkali extraction is very high. The color, which indicates the test limit, corresponds to the color of 0.1 ml. N/10 sodium hydroxide in 10 ml. of test solution. Ten ml. of test solution contains 0.04 ml. N/100 hydrohloric acid and if 0.1 ml. N/10 i.e. 1.0 ml. N/100 sodium hydroxide is added the resultant solution contains 0.96 ml. N/100 alkali. Adding the alkali amount, which is equivalent to 0.4 ml. N/100 acid present in the test solution, the grains could give off 1.36 ml. N/100 alkalies. This amount is three times the acid equivalent originally present in the test solution.

For testing ampoule glasses and ampoules I have developed and propose the following test, which eliminates all the sources of error, detailed above.

To a 250 ml. flask made of resistant glass and boiled

(*Continued on page* 32)

MAKING OF SPECTACLE LENSES at *American Optical Company*

American Optical secures its supply of opthalmic glass from Pittsburgh Plate on specification and then transforms it into finished lenses in its own plants.

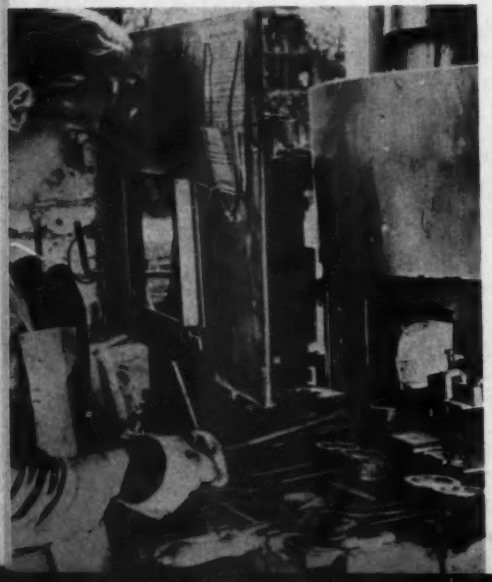
1. MAIN PLANT

(1) Main plant of American Optical Company where spectacle frames and other optical products are manufactured.

2. INSPECTING OPTHALMIC GLASS

3. REPORT ON ABSORPTION GLASS

4. MOULDING OF A LENS



(2) First step in the manufacture of lenses for defective vision is laboratory inspection of raw opthalmic glass. Above, B. J. Ziegler, physicist, is measuring the light bending power of squares of glass. This is one of many tests given to glass to ascertain its optical properties. Obviously, spectacle lenses of the highest quality can only be produced from glass of the same quality, hence these exhaustive scientific tests. (3) This picture shows a scientist making a report on absorption glass after certain optical tests have been made with the assistance of delicate measuring instruments. (4) The molding of a lens, one of the first steps in its manufacture. Squares of opthalmic glass are laid on the furnace and heated. Then they are slipped into molds and stamped out—at once rounded at the edge and curved over the entire surface. (5) Lens grinding room of the American Optical Company. Photos 3 and 4 are by Margaret Bourke-White.

5. LENS GRINDING ROOM

6. GRINDING LENSES

7. POLISHING LENSES

8. LENS INSPECTION

(6) Grinding and polishing the molded lens blanks to pre-determined thicknesses and curves is the next important step. The blanks are first set in pitch on accurately curved metal blocks shaped somewhat like flat helmets. Grinding laps fit over the blanks. As the blocks whirl around in the grinding operation, grinding compounds are poured over the lenses. Polishing by the same general method gives the lens surface the proper curves and a smooth finish. The same process must then be repeated for the other side of the lens. (7) Polishing the lenses at the Lensdale Plant of the American Optical Company. Grinding and polishing lens blanks to predetermined thicknesses and curves is one of the most important steps in the making of a lens. (8) Here an American Optical Company craftsman is inspecting for defects lenses that have just been ground and polished. (9) Another inspector is measuring the power and accuracy of a lens on the Lensometer, a delicate lens measuring instrument. All photos on this page but 6 and 10 are by Margaret Bourke-White.

9. THE LENSOMETER

10. CENTERING A LENS

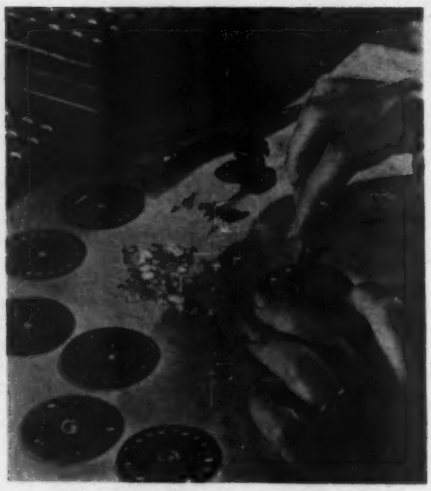
11. BIFOCAL MANUFACTURE

(10) Here an inspector is shown determining the optical center of a lens. Every lens is rigidly inspected for exact location of optical center, accuracy of power, thickness, and surface perfection, to mention a few of many inspections. (11) One of the many steps in the making of bifocal lenses which permit near and distant seeing. The operation shown consists of cleaning and placing together the two pieces of glass constituting the bifocal lens, preparatory to fusing together the segments and the countersink.

12. FINAL LENS INSPECTION

13. LENSES FOR EYE EXAMINING

14. THE PHOROPTOR



(12) An inspector makes one of the final inspections before the lenses are packaged. Lens precision can only be assured by severe inspection during every process of manufacture. (13) Here one sees the blocking of tiny lenses preparatory to grinding and polishing. These lenses, thousands of which can be held in the hand, are used in complex eye-examining instruments. They present a severe test of skill and their importance is obvious—an accurate eye examination is dependent, in part, on the accuracy of the test lenses. (14) Here a battery of test lenses is being installed in an eye testing instrument called the Phoroptor. This is one of the most amazing of the optical instruments, as its thirty-six lenses can be manipulated by professional men to obtain billions of prescriptions for glasses. (15) A metallurgist preparing a specimen of gold alloy to ascertain the gold content by assay.

15. ASSAY OF GOLD CONTENT

16. GOLD FOR SPECTACLE FRAMES

(16) A bar of gold alloy being rolled under tremendous pressures. Bit by bit the bar is reduced in size and finally drawn into gold wire used in the making of spectacle frames. (17) Flat strips of gold being measured by an inspector. This flat stock is used in making certain parts of spectacle frames. All photos on this page are by Margaret Bourke-White.

17. MEASURING GOLD STRIPS

THE MEANING OF TESTING PROCEDURES

By F. W. PRESTON

This article refers to the testing of bottles and other glass containers for the purpose of ascertaining their mechanical strength. The scientific development of testing procedures in this field is a comparatively modern affair, and the standardizing of them is even more recent. Prior to that time a variety of tests had been evolved, and out of them our present more precise methods were developed.

It seemed logical in those days to assume that all that was required was to bring the tests under such scientific control that all elements of uncertainty in the procedure would be eliminated, and everybody using the designated test would get the same result and the same information. The introduction of a certain uniformity throughout the nation would, it was thought, be a help in various ways. Different manufacturers' wares could be accurately compared by an agreed procedure; the ware made one day could be accurately compared with that of the next day or the next year; and a certain warranty could be offered the purchaser and the public that serious defects did not exist in the product sold.

The whole glass container industry collaborated remarkably in this work, which proved to be much more intricate than was at first expected. The factors affecting strength turned out to be both numerous and subtle, and a lot of the tests proved to be testing factors other than those they were thought to be testing.

It very soon became evident that ability to carry out any sort of a standard test would demand standard testing apparatus, and that this would not be any too simple. To get the necessary precision, and reproducible results, testing machines distinctly more ambitious than anything hitherto on the market would be needed. Otherwise some factor would be left unstandardized and variable results would be obtained.

The evaluating of the variables, and deciding which factors were important and which were not, and how important they were, has produced our present set of testing machines and apparatus, mostly made by the Polaroid Corporation and the Preston Laboratories.

It was expected that this would produce a certain stability, and in fact it has done so, but it has certainly not produced stagnation or fossilization. For with the improved knowledge that came from more precise testing, manufacturing techniques were in their turn improved. This result was of course foreseen and emphasized years ago by Mr. Ackerman. What was, I think, not clearly foreseen, was that the improvement in manufacturing techniques would call for further developments in testing procedure and probably for additional tests or substitution of one test for another.

A lot of the complications arise from the fact that what is tested is not the substance (glass) but a finished article (e.g. a bottle). All the early tests, of a decade or two ago, were on this basis. They were usually "simulative" tests, designed to find out whether a bottle could be expected to survive the treatment it would experience "in trade." Thus a bottle intended to hold carbonated beverages is going to have to stand up against internal hydrostatic pressure. Therefore it is logical to test it with internal hydrostatic pressure to see if it is equal to the job.

Again, a bottle is taken from the hot sun and placed in an ice box, which is commonly designated a "thermal shock." To find out whether it is equal to this service, the bottle was given an experimental shock. The factors that make for good thermal shock resistance were not all known, in fact most of them were unknown. But the simulative test could be made on the actual bottle, and if it didn't break, presumably it wouldn't break in subsequent service.

It was recognized very early that there was no means of "testing glass as glass" for this purpose, though there was some bewailing of the fact. Whether anyone ever had a clear concept of "glass as glass" or "testing glass as glass" is not certain; the present writer doubts it, and has not attained to any clear concept thereof himself. At any rate it seems impracticable to warrant the behavior of a bottle by making a test of a proof from the tank. This last procedure may give a good idea of the color of the prospective bottle, or of its chemical analysis; but it will have little bearing on its ability to stand internal pressure, or its ability to stand a thermal shock.

Again, it was early recognized that chemical composition had next to no bearing on mechanical strength proper (e.i. hydrostatic strength), and that over the range of practicable chemical compositions, there was next to no hope of obtaining a substantial improvement even in thermal shock resistance. Modest chemical changes of composition such as were otherwise practicable could produce remarkable improvements in chemical durability against particular contents, but they had no very great influence on mechanical properties.

The idea existed five years ago, and still exists, because it is partly true, that "design" has a lot to do with mechanical strength. The influence of design has in fact been discussed in a number of papers from this laboratory,* and some of the improvements have been remarkable.

But it has always been clear, and tends to become clearer, that the details of manufacturing technique are often still more important, and that bottles of identical design may vary greatly in strength. In fact, a great deal of the effort that has been made to improve bottles through design, has been frustrated by deficiencies in manufacturing techniques.

The present article, however, concerns the testing procedures as such, and the history of their development. Obviously, since we are not dealing with a static industry, in view of all that has been said above, we are not dealing with a static testing procedure. We have to watch that our testing procedures do not become irrelevant.

For instance, when the thermal shock test first became of general interest, and this seems to have originated in

*F. W. Preston, *Jr. Amer. Cer. Soc.*, Vol. 23, No. 4, 1940, "Stresses in Bottles or Jars from Differences in Outside and Inside Temperatures (Static Temperature Gradient)."

L. G. Ghering, *The Glass Industry*, Vol. 20, No. 12, 1939, "Improving The Strength of Glass Containers Through Design."

F. W. Preston, *The Glass Industry*, Vol. 21, No. 6, 1940, "Bottles for Internal Pressure."

F. W. Preston, *The Glass Industry*, Vol. 21, No. 12, 1940, "Bottles for Internal Vacuum."

Art Williams' visit to Berney Bond a good many years ago, it came to be looked on, in many plants at least, as a test for homogeneity of the glass. If the glass were very cordy, it was supposed the test would break it. If the glass did not break, on the other hand, then presumably the glass was not cordy, or at any rate "not bad."

In those days polariscopes were not in general use, those that were used were inconvenient and low powered, and what you saw in the polariscope you couldn't interpret anyhow. How could you say, by looking in a polariscope, whether the glass would break or not? The thermal shock test was more to the point. The bottle either broke or it didn't.

But as time went on, two things happened. There was a general improvement in homogeneity due in part to more general use of polariscopes and to improved operating techniques, and there was a greater understanding of fracture patterns. By and by it was found that while the thermal shock test still retained its simulative character and was still qualified to act as a sort of warranty for the bottle as a whole, yet in general it was not testing homogeneity. More often it was seeking out manufacturing defects, such as bad shear marks or "cut-offs." In the case of syphons, these seemed never to influence the result, and the test then sought out bruises acquired subsequently to manufacturing. A somewhat similar development occurred in Mason Jars. In some cases other defects were sought out, but in general cordiness was not one of them.

The same plants that, of old, regarded thermal shocks as a test of cordiness, told me they regarded the pressure test as a test for thin seams and thin spots generally. In the absence of thin spots, it was believed that the bottles were always adequately strong. In those days, plenty of glass in the bottle was the remedy for any weakness, but those were the days when the labor cost had scarcely been reduced to the point where the material in the bottle was a prime consideration. In recent years we have used much less glass and still had stronger bottles.

As soon as fracture diagnosis was applied on a generous scale to seeing what it was that limited mechanical strength, it was found that normally the hydrostatic pressure test was more apt to seek out bruises, chill checks, infolded shear marks and the like, and that thin glass in good condition was stronger than thick glass that had been abused. This resulted in greater care in some manufacturing procedures, and probably it also gave a certain impetus to the "light-weighting" program of recent years.

Among other things that were naturally discovered was the fact that relatively thin spots near the Murgatroyd belt were less dangerous, as a rule, so far as internal pressure is concerned, than equally thin spots half way up the barrel. The stiffening effect of a neighboring base is sometimes an advantage in pressure resistance. But this is not the case so far as resistance to impact is concerned. On the contrary, the stiffening is a disadvantage, for under impact the sidewalls are springy till we near the base, where, in effect, we put an anvil under our hammer and trap our sidewall between the two.

Now certain methods of manufacture are much more apt to produce thin spots at the Murgatroyd belt than others; and certain designs are more favorable than others. Further, it is almost unknown for commercial bottles to fail by internal pressure alone, while they often fail from impact alone. Hence there is a growing belief that ultimately some sort of impact testing will be desirable, though at present there is no consensus of opinion as to how such a test can best be carried out. The methods devised at this laboratory have recently yielded a good deal of interesting information on this subject. In some directions they have merely confirmed the ideas of Mr. Collins of Consumers Glass, now rather generally incorporated in Canadian practice, though not yet in U. S. practice; in other directions they seem to be new.

It seems to come about, in the case of certain bottles, that each test picks out a certain vulnerable feature. For instance the hydrostatic test in most bottles picks out the weaknesses of the shoulder and sidewall, and ignores the neck, and sometimes the base. The thermal shock test is more apt to test the base than the sidewalls, except in syphons; but sometimes it tests the Murgatroyd belt. Typically the impact test concentrates its attention on this latter, unless the bottle is damaged internally, whereon it concentrates on internal damage to the virtual exclusion of everything else.

These things were not originally recognized, nor are they universal truths. They are true, or have been true, with the sort of bottles we have been using. A radical change in shape of bottle, distribution of glass in the bottle, or amount of glass in the bottle, would probably change the places that the various tests attack. It is necessary to recognize this and to be on the watch for it. This of course is where the importance of fracture diagnosis comes in. It is not enough to test a bottle and record a figure on a dial: it is necessary to look at the fragments if they contain anything abnormal.

In the meantime, so much improvement has taken place in normal commercial homogeneity of bottles, although it has not equalled the improvement in the homogeneity of flat window glass, that it is doubtful if there will be more than occasional trouble from this cause. A modest amount of heterogeneity (cord) seems to have no measurable effect upon strength, though theoretically it should. This discrepancy is probably due to the fact that as things stand now, certain other defects in the manufacturing process cause slightly more trouble than heterogeneity, so that neither a pressure test nor a thermal shock test may reach the level of severity where modern cordiness is the deciding factor. Before we can test the cord, the bottle breaks from a bruise, a cut-off mark, or something of that sort.

The polariscope of course does not detect these latter matters. If it detects anything, it detects the heterogeneities, though as Mr. Swicker has pointed out, it sometimes calls for ring-sections to render anything very obvious. But the polariscope also detects annealing stresses, whether the glass is homogeneous or not, and so has a field of its own. The other methods of determining annealing temper are less precise than the polariscope; but on the other hand, the quantitative estimation of heterogeneity is particularly difficult thereby.

This of course brings us to a consideration of the centrifuge method for estimating heterogeneity, which we owe to Dr. Turnbull.* As yet this is only in the development stage but it is not inconceivable that ultimately the centrifuge will replace the polariscope en-

tirely in this field, particularly as the technique improves and is simplified, which of course is happening right along. It is, however, conceivable that still newer methods may replace both.

While the thermal shock test, the hydrostatic pressure test, and the impact test are "simulative," and are quite without merit (in the field of glass containers) unless they are tried on the finished product, (i.e. the bottle), the polariscope is not in the ordinary sense simulative, and the centrifuge is not simulative at all.

A bottle in real life may get a thermal shock or an impact, which may break it; but it will not be made part of a polariscope, nor will it break if it is. The polariscope is not a mechanical test. It is an optical test, and it is less a test of the bottle than of the lehr and tank that produced the bottle. True, we are looking for information on the probable behavior of the bottle as a mechanical container, but in this respect we have an inspection rather than a mechanical test. The information is indirect, and it is quite difficult to warrant the bottle on such a basis.

The centrifuge is a test rather than an inspection; it yields quantitative results, but it is certainly not simulative. Neither the bottle nor the powder therefrom is expected ever to be centrifuged, still less to be centrifuged under the highly artificial conditions of the test. When under test, the glass is not a bottle, nor need it ever have been a bottle. The test could be applied to the glass in the tank, and would then become a measure of tank operating technique. But if the glass had been a bottle, the test would give some quantitative information about the bottle that could be obtained in no other way at present. Nonetheless, the bottle as a whole cannot be guaranteed solely on the basis of the glass that is in it, any more than an automobile can be guaranteed by the steel in it.

It is, or has been, a frequent lament that there is not one simple, single test which would warrant a bottle commercially sound. Perhaps we hear less of that lament than we used to do, but we can sympathize with it. It is now becoming generally recognized that the three tests which seemed originally to be legally required (for pressure ware), viz. thermal shock, hydrostatic, and polariscopic tests, are not duplications of each other, not tests that check the same thing in three different ways. They actually determine three different kinds of fitness, and a bottle, simple and uninteresting as it may be (apart from its contents) is too complicated to be assessed by any one test.

This article is written, however, to point out that with changing, and in general, improving techniques of design and manufacture, our tests do not in every instance necessarily test precisely what they were originally designed to test. This calls for alertness on the part of testing department personnel. It is not simply a case of putting in a testing department, equipping it with standard equipment, and grinding out routine tests every day. This is very valuable, and will be both a defense at law and a means of improving operating efficiency. But nothing will replace brains in the testing department. The mechanical equipment is necessary, but the brains can never be dispensed with.

*J. C. Turnbull, "Separation of Inhomogeneities in Bottle Glass by Density Differences," to be published in *Jr. Amer. Cer. Soc.* February or March, 1941.

E. G. ACKERMAN TO HEAD THATCHER

The Board of Directors of Thatcher Manufacturing Company, Elmira, N. Y., at a meeting held on December 11, elected Mr. E. G. Ackerman as director and president. Mr. R. W. Niver, who retires as president, has just completed forty years of service with Thatcher, will remain as a director and in a consulting capacity.

Mr. Ackerman was born near Kendellville, Ind., and was educated in Indiana University and the University of Pennsylvania. He joined the regular army and was commissioned after attending the Officers' Training School. After his graduation from college in 1920 he joined the engineering staff of Stevenson, Jordan and Harrison. From 1922 until 1926 he was connected with a number of different glass companies, including Gleason-Tiebout Glass Co., U. S. Glass Company, Fostoria Glass Company, Morgantown Glass Works, Monongah Glass Company, Mound City Glass Company and the Tygart Valley Glass Company. Since 1926, Mr. Ackerman has been affiliated with the Glass Container Association, becoming its manager in 1929. In 1933 he was made a senior partner of Stevenson, Jordan and Harrison.

C. J. RICHTER JOINS McKEE GLASS

Mr. C. J. Richter has been appointed chief engineer for the McKee Glass Company of Jeannette, Pa. Mr. Richter was formally superintendent of the Pilkington process for Libbey-Owens-Ford at Ottawa, Ill., and more recently director of research for the Fourco Glass Company, Clarksburg, W. Va.

FORTIETH ANNUAL EXHIBITION OF NEW YORK SOCIETY OF CERAMIC ARTS

The 40th Exhibition of The New York Society of Ceramics will be held on February 1 at The National Arts Club, 15 Gramercy Park, New York City. The exhibition will stress individual craftsmanship and will be open to all forms of ceramic art, including pottery. titles, terra cotta, glass, stained glass, and enamelled metal. Exhibitors, excepting sculptors, will be limited to five pieces not previously exhibited. Sets will be considered as one piece. The entrance fee will be $3.00 to members and $5.00 to non-members. A competent jury will pass on all work submitted. The commission on sales will be 25 per cent, and all work should be for sale or may be duplicated. Further information regarding this exhibit may be obtained by writing John T. Ogden, THE GLASS INDUSTRY, 11 West 42nd Street, New York City.

B & L CUTS LINE ONE THIRD

The Bausch and Lomb Optical Co. has discontinued manufacture of one-third of its line, according to Edward S. La Rose, comptroller of the company, in an address before the ninth annual meeting of the Comptrollers Institute of America at the Waldorf-Astoria in New York. This one-third represents only 3 per cent of the company's sales. The company is accepting defense orders only to the extent of its capacity to turn out the necessary materials. Mr. La Rose pointed out that during the world war the company accepted large government orders and as a result found itself, "in the red from 1920 to 1926."

CURRENT STATISTICAL POSITION OF GLASS

In the February issue of THE GLASS INDUSTRY (pages 76 and 77), we looked forward ten months and reported our estimates on the total value of glassware manufactured in 1939 as $320,000,000 and the number of wage earners as 70,000. The preliminary report of the United States Census for the year 1939 has just been released and shows that our estimate was uncommonly close. The statistics are published on page 35.

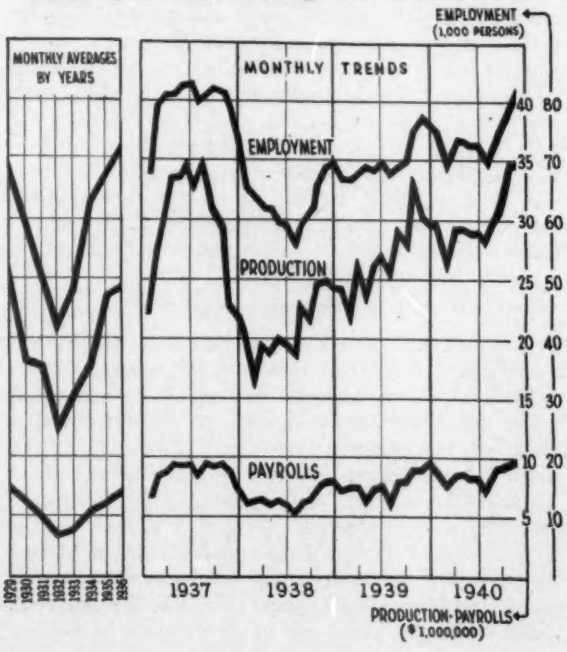
During November the glass industry established a new production high for this month of the year which brough 1940 totals to a record peak. Increased employment and payrolls accompanied this accellerated activity; exports were unusually large as imports continued to decline. Assocrding to THE GLASS INDUSTRY's Production Index, output during November was valued at $35,000,000; cumulative totals for the eleven months placed 1940 production at $335,000,000 as compared to $293,000,000 last year and $334,000,000 in 1937 when the previous record was set.

Plate glass production during November totalled 16,059,294 square feet according to the Plate Glass Manufacturers of America. This was 6 per cent less than the previous month's total but was 2 per cent greater than in November of last year. During the eleven months of 1940 plate glass output totalled 146,880,000 square feet which indicates that this year's activity has been 19 per cent greater than 1939's.

Window glass production during November amounted to 1,264,057 boxes as compared to 1,348,895 boxes in October. During the first eleven months of this year window glass output totalled 12,220,000 boxes—an increase of 27 per cent over 1939's comparable figure.

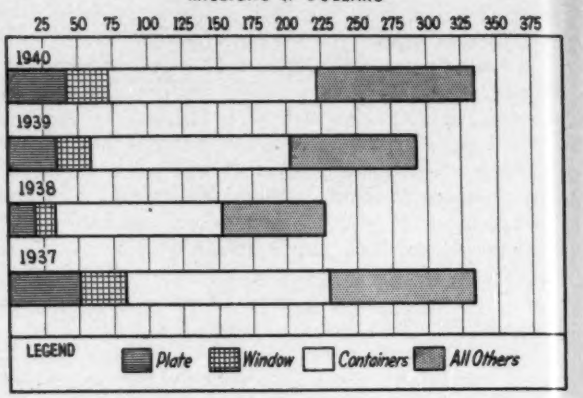
GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through November, 1940



GI THE GLASS INDUSTRY'S INDEX

Production for Eleven Months, January Through November

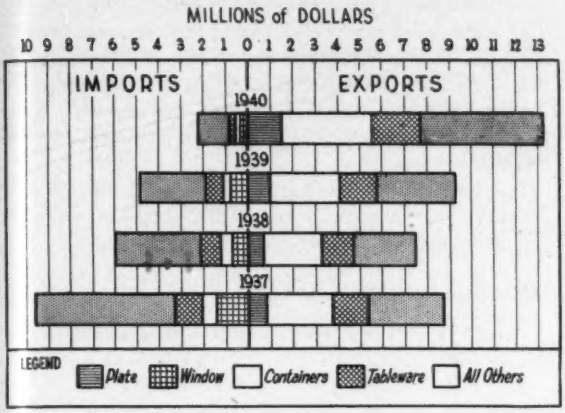


Glass container output during November totalled 4,351,509 gross according to the Glass Container Association. This was 11 per cent less than October's volume because of declines of 10 per cent in medicinal and toilet ware, 19 per cent in food containers, 7 per cent in liquor ware, 7 per cent in pressure and non-pressure ware and 10 per cent in milk bottles. Beer bottles were the only types of containers which were produced in larger quantities during November increasing 10 per cent over October. Compared with November of 1939 this year's production was up 1 per cent. All lines, with the exception of medicinal, toilet, and liquor ware and beer bottles followed this upward trend. Gains of 21 per cent were reported for food containers, 18 per cent for general purpose ware, 6 per cent for milk bottles and 3 per cent for pressure and non-pressure ware; the declines in medicinal and toilet ware, liquor containers and beer bottles were 10 per cent, 3 per cent and 24 per cent respectively. Cumulative figures for the January-November period indicated that 1940's output will break all previous records. On the eleven month basis this year's activity has been 6 per cent greater than 1939's and has exceeded 1937's record by 2 per cent.

Glass container shipments during November amounted to 4,077,936 gross which was 15 per cent less than the October figure. Medicinal and toilet ware was down 23 per cent, food containers 27 per cent, general purpose ware 20 per cent and milk bottles 2 per cent, but increases of 11 per cent, 23 per cent, and 14 per cent respectively were reported for liquor ware, beer bottles and pressure and non-pressure ware. Compared with last year, November's shipments were 5 per cent higher, despite declines of 9 per cent in medicinal and toilet ware and 8 per cent in general purpose ware. Food container volume was up 22 per cent, liquor ware 10 per cent, soft drink bottles 36 per cent, beer bottles 3 per cent and milk bottles 7 per cent. Cumulative statistics for the first 11 months of 1940 indicated a record shipment total which exceeded last year's by 6 per cent. All types of ware were sold in greater quantities with beer

THE GLASS INDUSTRY'S INDEX

Foreign Trade for Eleven Months, January Through November



bottles up 26 per cent, pressure and non-pressure ware 22 per cent, liquor ware 11 per cent, general purpose ware 6 per cent, food containers 4 per cent and milk bottles 2 per cent. The record shipment volume set by this industry in 1937 has been exceeded by 3 per cent according to a comparison of January-November totals.

Stocks-on-hand as of November 30th totalled 9,432,190 gross which was 13 per cent higher than on last year's comparable date. In line with this industry trend, inventories of all types of ware, with the exception of milk bottles, were higher.

Miscellaneous glass products manufactured during November were valued at $14,000,000 according to reliable estimates. This represented an increase of 8 per cent over the previous month which was largely due to expanded production of handmade glassware for the holiday trade and stepped-up activity in the factories producing industrial, technical and scientific ware. Sales of automatic tumblers totalled 2,803,558 dozens as compared to 2,700,304 dozens in November 1939. Shipments of machine made table, kitchen and household ware amounted to 3,006,386 dozens which were 1 per cent less than in last year's comparable month.

Employment and Payrolls: Approximately 81,500 persons were employed in the glass industry during November recording the highest total since September 1937. This compared favorably with 79,000 in the previous month and 77,000 in November of last year.

Payrolls in the glass industry during November were estimated at the all-time monthly high of $10,000,000. Last November they totalled $9,000,000. In eleven months of 1940 glass makers paid about $94,000,000 to employees, 13 per cent above last year's total.

Foreign Trade: Exports of glass and glass products during November reached the record level of $1,770,000. This was an increase of 22 per cent over the previous month. All types of ware were exported in larger quantities during this month with window glass shipments almost double their October volume, plate glass up 86 per cent and illuminating ware 43 per cent. Compared with November of last year this volume represented an increase of 66 per cent. This was due in part to gains in window glass of 1530 per cent, illuminating ware 119 per cent and in containers 54 per cent. Cumulative totals for the current year on an eleven months basis reveal a foreign sales total of $13,218,000 or 41 per cent more than in 1939's comparable period. This reflected the jump of 1066 per cent in window glass sales and the more moderate increase of 62 per cent in illuminating ware, 40 per cent in plate glass, 35 per cent in containers and 26 per cent in tableware.

Imports of glass and glass products during November dropped to a new low of $110,000, or 11 per cent below October's reduced volume. Trade in all lines followed this general trend with the exception of illuminating ware which increased to $9000, from $5000 in October. The November volume represented a decline of 84 per cent from November of last year with all lines experiencing reduced activity. Declines in the various types of products ran from 74 per cent in illuminating ware to 92 per cent in plate glass. During the eleven months of 1940 imports were valued at $2,198,000 as compared to $4,851,000 last year. Plate glass was the only item which increased during this period.

UNITED STATES FOREIGN TRADE IN GLASS

(Values in Thousands of Dollars)

	1940			1939		Percentage Changes		
	November	*October*	*Eleven Months*	*November*	*Eleven Months*	*October-November*	*November-November*	*Eleven Months*
EXPORTS								
Plate	182	98	1403	122	1005	+86	+ 49	+ 40
Window	163	84	583	10	50	+94	+1530	+1066
Containers	529	442	4182	348	3104	+20	+ 54	+ 35
Tableware	265	229	2208	198	1759	+16	+ 34	+ 26
Illuminating Ware	92	64	666	42	411	+43	+ 119	+ 62
All Other	546	537	4176	352	3068	+ 2	+ 55	+ 36
Total	1777	1454	13218	1072	9397	+22	+ 66	+ 41
IMPORTS								
Plate	1	1	118	12	70	....	— 92	+ 69
Window	6	7	341	63	766	—15	— 90	— 55
Container	5	10	138	30	310	—50	— 83	— 56
Tableware	16	21	391	63	812	—24	— 75	— 52
Illuminating Ware	9	5	70	23	361	+80	— 74	— 81
All Other	73	80	1140	436	2532	— 9	— 84	— 55
Total	110	124	2198	627	4851	—11	— 84	— 55

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During November

Compositions

General Electric Co. received through assignment from Mitsuo Hirose and Hiroshi Kamogawa of Kawasaki, Japan, a patent 2,220,765 for a glass composition to be used as dielectric material for condensors. Composition ranges were stated in mol percentages as 20 to 25 per cent titanium oxide, 36 to 41 per cent lead oxide, and 33 to 38 per cent silica. Modifying ingredients such as 2.4 per cent alumina may be used.

The work carried on under the sponsorship of Norbert S. Garbisch to make plate glass grinding waste available as a batch constituent, has previously been mentioned in these columns. Another patent, 2,220,750, resulting from this project has just been issued to George J. Blair of Mellon Institute, Pittsburgh and Robert A. Miller, Tarentum, Pa. In this latest patent emphasis is placed on a nodulizing process applied to the purified sand and glass waste product, after adding suitable amounts of the alkalies and alkaline earth materials normally used in glass manufacture.

A third in the Corning Glass Works' group of "Vycor" patents, covering articles made of 5 per cent boric oxide, 0.5 per cent R_2O_3 and the balance silica, was issued to Harrison P. Hood and Martin E. Nordberg (2,221,709). The basic process, covered by their two earlier patents, wherein the shaped glass articles are shrunk together after a leaching process has given the glass a porous structure, was described in the November 1940 issue of THE GLASS INDUSTRY. The latest patent is based on further investigation which has shown that the tendency of the glass to swell or shrink and to produce undesirable strains during leaching, requires a rigid control of composition and other factors. A range of compositions free from these volume changes has been established. The patent claims define the final product as having 94+ per cent silica, 0.05 to 0.25 per cent alkalies, 2 to 6 per cent boric oxide, and in some instances 0.5 to 2.0 per cent alumina.

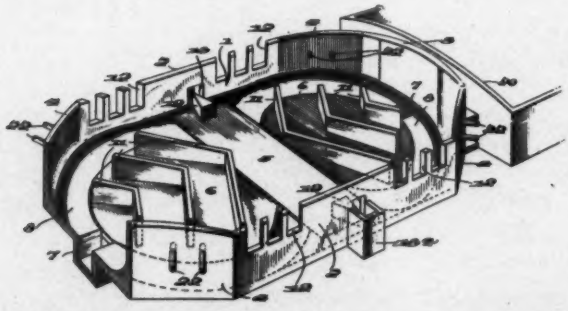


Fig. 1. 2,222,816: King. In this perspective view of a center-charged melting furnace, the batch is charged at 18 and 18a onto an upraised platform 5, from which the floor tapers to the furnace walls and then to the forehearths 20 at each end, from which forming machines are fed. In this view the left end forehearth is cut away by the manner of sectioning through the throat 7. The burner ports 12 converge on the melting zone and may be aided by auxiliary burners 22. Baffles 11 are to aid in directing glass movement toward the walls and to prevent short-circuited travel toward the throats.

Furnaces

A novel center-fed melting tank, designed to accommodate bottle machines at each end of the tank, was patented by Cecil C. King of Millvale, N. J. (2,222,816). As shown in Fig. 1, the batch is charged at the center, at both sides, onto a slightly elevated platform. Flow toward the forehearths is baffled to prevent short circuiting.

A paddle for operating in the forehearths of glass furnaces was covered by patent 2,220,635 to Frederick W. Armytage of Knottingley, England.

Miscellaneous Processes

A lehr charger was covered by patent 2,220,454 to Wilbur S. Mayers, Toledo, (Frangeo Co.).

Patent 2,221,737 to Eli M. Long, Geneva, N. Y., is a lens edging machine assigned to Shuron Optical Co.

Methods of making glass-to-metal seals were covered by four patents, of which two were assigned to General Electric Co. One of these two was 2,221,868 granted to Walter J. Geiger and Wilson Davidson, Cleveland, and the other was 2,220,742 issued to Harry L. Thorson, Schenectady. Thorson's invention applies to the preparation of lead-in conductors for metal radio tubes. The usual manufacturing procedure is to slide a short section of glass tubing onto the conductor, which is later treated with a flame to seal it to the conductor and to the head of the tube. Thorson's preparation method shown in Fig. 2 consists in feeding powdered glass onto the rotating conductor while a flame simultaneously fuses the glass to the conductor. A third metal-to-seal patent was 2,223,031 assigned by Donald V. Edwards of Montclair, N. J. to Electrons, Inc. Two elements of a vacuum vessel are sealed together by applying a vitreous surface to one of them, then heating under vacuum to form the seal and then cooling it in the vacuum chamber. Semon H. Stupakoff of the Stupakoff Laboratories, Inc., Pittsburgh, obtained patent 2,220,690 for a construction panel in which glass and metal of predetermined expansion characteristics are sealed together by fusing the glass.

Katherine B. Blodgett of Schenectady proposes in patent 2,220,862 (General Electric Co.) to improve the optical properties of a body of soda-lime glass by fusing to it a layer of a second glass containing a metallic constituent which imparts a high reflective power to the second glass, and then superficially etching the second

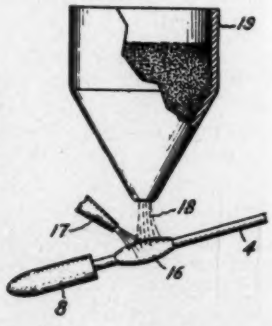


Fig. 2. 2,220,742: Thorson. The glass seal for a conductor 4 for metal radio tubes is applied as powdered glass onto the rotating conductor and fused simultaneously to it by a gas flame.

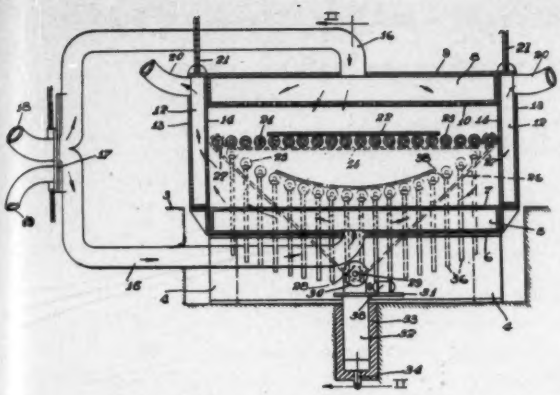


Fig. 3. 2,223,124: Owen. In this apparatus for bending and case hardening sheets, the rollers 23 are dropped to positions giving the desired curvature, and are rotated continuously during heating and chilling to avoid marring the sheet.

glass to remove the metallic constituent to a depth corresponding approximately to a quarter wavelength of a given component of visible light.

A method of depositing fluorescent material on the inner walls of a glass container has been invented by Bernard C. Gardner, Philadelphia, (2,221,474, Farnsworth Television & Radio Corp.). First a uniform coating of liquid binder is condensed on the container walls, then a cloud of finely divided dry fluorescent material is allowed to settle by gravity onto the binding layer.

Plate and Sheet Glass

Some of the glasses used for absorbing or interrupting the shorter actinic rays, such as ultra-violet and x-rays, weather or tarnish readily so that transparency tends to be lost. Robert A. Miller of Tarentum, Pa. (Pittsburgh Plate Glass Co.) in patent 2,223,118 proposes to protect both surfaces of sheets of these high-lead glasses and others of similar type, with thin sheets of weather-resistant window glass. These protective sheets would be attached by adhesives such as vinyl acetal resin.

Pittsburgh Plate Glass was assignee of three patents granted to William Owen of Pittsburgh. Patent 2,223,122 is a lehr drive for sheet glass machines. The rolls which support the sheet are driven from both ends to avoid twisting, and the pressure between the rolls of each pair is automatically controlled by the traction which the rolls apply to the sheet being drawn, so that there are no weights or springs to adjust. The other two Owen patents are concerned with methods and apparatus for bending and tempering or case hardening glass sheets. As shown in Fig. 3 patent 2,223,124 avoids the use of supporting tongs by supporting the sheets on rollers which are kept in motion to avoid marring the sheet while it bends under gravity, as the rollers are depressed to positions which define the final curvature. The motion of the rollers is subject to reversal, so the sheet can be given a backward and forward motion to allow the entire sheet to be exposed first to heat and then to the chilling blast. In the third Owen patent, 2,223,123, bending is accomplished in an apparatus wherein the sheet is supported on spaced wires.

A modified method of making laminated glass was patented by Frederic L. Bishop, Robert H. DuBois, and Patrick Finnegan of American Window Glass Company, Pittsburgh. Patent 2,221,367 provides steps consisting of forming a film of a strengthening material, flowing it onto one surface of one or two glass sheets, drying the film, and uniting the two sheets with the strengthening material between them.

A light polarizing device was patented by Alvin M. Marks of Whitestone, N. Y. (2,220,111).

Glass Wool and Fiber

A novel glass wool electric melting furnace, which is reported by Owens-Corning Fiberglas Corp. as being extremely flexible, has been patented by Edmund H. Wellech of Corning. Details of this invention, U. S. patent 2,220,433, are shown in Fig. 4. The furnace is mounted on trunnions so it can be tilted to allow tiny streams of glass to flow out through notches. Another Owens-Corning Fiberglas patent is 2,220,127 granted to Games Slayter, which covers glass wool in an air filter of particular design.

Logan W. Mulford, Kew Gardens, N. Y. received patent 2,221,649 for a glass block with a light filtering panel of glass fibers through the middle and solidified to the rim of the block at the seal.

Details of a blowing nozzle for fiberizing mineral wool were assigned to Johns-Manville Corp. in patent 2,221,011 allowed to Hermann F. Vieweg and associates. Another method of making mineral wool was patented by Charles F. Ramseyer, Chicago, Ill. (2,223,047), whose process is to burn powdered coal in an oxidizing atmosphere at a temperature which melts the ash to give a liquid which is collected and formed into mineral wool.

Patent 2,223,086 granted to Robert C. Williams and James F. Hall of the Ironsides Co., Columbus, Ohio, provides an air drying binder for glass or mineral wool fibers. It is described as comprising 15 to 30 parts of mineral hydrocarbon polymers resulting from the polymerization of unrefined vapor-phase cracked gasoline, from 15 to 47 parts of a rosin component, and a removable solvent.

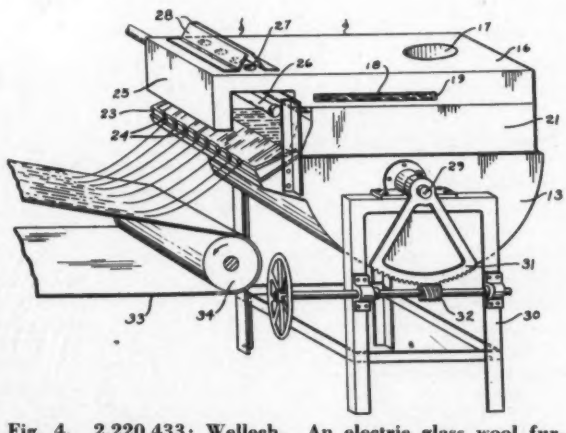


Fig. 4. 2,220,433: Wellech. An electric glass wool furnace heated by electric elements 18 in the flat roof and bottom, is mounted on trunnions, so that tilting will allow the glass streams to flow through notches in the extended metal sheet which lines the furnace. The furnace is charged through the top 17, and is operated as a batch unit. Diameter of fiber is in part controlled by the speed of the conveyor.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	43.00	46.00-49.00
Reduction on precipitated material, $5.00 a ton		45.00	50.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated, In bags,	lb.	.0215	.027 -.0295
Powdered, In bags,	lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated, In bags,	lb.	.048	.054 - .0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	29.00	....
In bags	ton	30.60	40.00-42.50
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.08	....
In 5 Ton lots	lb.	....	.085
Less than 5 Tons	lb.	....	.09
Lime—			
Hydrated ($Ca(OH)_2$-MgO) (in paper sacks)	ton	8.50	8.50
Burnt (CaO-MgO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums, Per drum		1.60	1.70
Kiln Dried ($CaCO_3$-$MgCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$-$MgCO_3$) 16x120 mesh.	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.00	15.00
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	18.00-20.00	25.00
in bulk		16.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, Flat Per 100 lb		.95	....
In barrels, Per 100 lb.		1.35	....
In bags, Per 100 lb.		1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls, Per 100 lb.		....	2.50-2.90
95% and 97%			
Bulk, Per 100 lb.		1.35	....
200 lb. bags		1.44	1.465
100 lb. bags		1.475	1.50

Special Materials

		Carlots	Less Carlots
Aluminum hydrate (Al $(OH)_3$)	lb.	.026-.029	.04
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.13	.14½
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	....	.09-.10
Tin Oxide (SnO_2) in bbls	lb.	....	.54
Titanium Oxide (ceramic grade)			
In bags	lb.	.13	.13¼-.13¾
In barrels	lb.	.13¼	.13¾-.14
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06½	.06¾
White Seal, 150 lb. bbls	lb.	.09	.09¼
Green Seal bags	lb.	.08¼	.08½
Domestic White Seal bags	lb.	.08¾	.09
Red Seal, bags	lb.	.07¾	.08
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	07-.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.00-1.05
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls	lb.	....	.22-.25
Chromite (99% through 200 mesh)	ton	45.00	48.50
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cobalt oxide (Co_2O_3)			
In bbls, 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.165
Black (CuO)	lb.	....	.18-.19
Black prepared	lb.	....	.22
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.05-.09½
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls	lb.	....	.135
Lithium Carbonate	lb.	....	1.00
Manganese, Black Oxide (Caucasian)			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.08¾	.09-.09¼
Powdered	lb.	....	.09¼-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21-.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08½	.08¾-.08½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.55-1.65
Yellow	lb.	....	1.55-1.65
Sulphur (S)—			
Flowers, in bbls, Per 100 lb.		3.35	3.70-4.10
Flowers, in bags, Per 100 lb.		3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls, Per 100 lb.		2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.45-2.55
Yellow orange	lb.	....	1.55-1.65

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.063	.07
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	....	open price
0, 0½, ½, 1.	lb.	....	open price
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	02¼	.03½
Rouge, Red	lb.	....	.16
Black	lb.	....	.18

NEW EQUIPMENT AND SUPPLIES

REZNOR UNIT HEATERS

A new line of gas-fired unit heaters has recently been introduced by the Reznor Manufacturing Co., Mercer, Pa. The new heaters need no water or steam for operation. Three types, each of which is available in five sizes to provide from 55,000 to 200,000 btu, are included in the line.

The fan type heater is equipped with a four-blade, electrically-driven propeller fan. This fan, situated behind the heater cabinet, drives cool air of the room over the streamlined heat exchanger and thence into the room, the air being heated in the process. Because of its streamlined design, the heat exchanger reduces air noise to a minimum and said to provide almost perfect heat transfer. Products of combustion are carried from the combustion chamber into the flue chamber and then to the chimney or flue and do not come in contact with the air being heated.

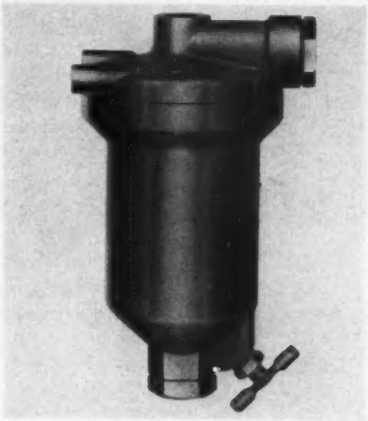
Blower and duct type unit heaters correspond in design and operation to the fan type heater except that the blower type is equipped with a blower instead of a fan and the duct type is equipped with neither blower nor fan. The blower type is especially efficient where the installation must be made in connection with duct system, because of the air resistance encountered in such a system. The duct type heater is designed especially for use in a system where the air is supplied by a remotely situated blower of proper capacity for the total number of duct unit heaters employed.

All of the heaters can be furnished to burn natural, manufactured or liquefied petroleum gas, and are completely equipped with automatic controls, for safe and efficient operation.

Reznor Unit Heater

AUTOMATIC WATER DRAIN

A new automatic water drain for use in compressed air lines is now being marketed by the DeVilbiss Company, Toledo, Ohio, and is stated to be simple in construction, positive in action. and trouble-free in operation. This drain, known as type HOD, is intended for installation in air lines, on air compressing outfits, or air receivers. The HOD automatically drains the air line or air receiver, preventing water from being carried into the tool being used, and assures a supply of air free from any moisture. Use of the drain is especially desirable in the spray painting field, where its use will insure against the possible deposit of moisture on freshly finished surfaces.



DeVilbis Automatic Water Drain

The drain operates automatically by a slight fluctuation of the main line air pressure; a variation of as little as five pounds is sufficient for its operation. A manual drain is provided for use in periods when the main air line is not in use.

PENN SALT EXPANDS

The Pennsylvania Salt Manufacturing Company, Philadelphia, announces that they have purchased approximately 50 acres of land on the Willamette River in Portland, Oregon, on which it will start the erection of a chemical plant. The first unit will be for the production of sodium and potassium chlorates, and it is expected that later the plant will be increased to produce various chemicals by electrolytic and other processes. The Chipman Chemical Company of Bound Brook, N. J., will cooperate with the Salt Company in the sale and distribution of sodium chlorate.

The new plant will be supplied with power from the Bonneville Dam. Its proximity to the Portland Gas and Coke Company offers many advantages because of the availability of a supply of raw materials from that source for the manufacture of organic chemicals. The plant location will be such that it can be served by water, rail and highway transportation.

CATALOGS RECEIVED

South Bend Lathe Works, South Bend, Ind. Catalog No. 16-T illustrating and describing the new 16 in. series "S" lathes, which are made in three types: Tool-room, Quick Change Gear, and Standard Change Gear. Each type of lathe is available with underneath motor drive, pedestal motor drive or countershaft drive and in different bed lengths.

The Hays Corporation, Michigan City, Ind. The publication of a series of educational engineering monographs in connection with boiler room instrumentation and automatic combustion control. These monographs will be sent to any engineer requesting them at no cost or obligation.

The Cleveland Tramrail Division, The Cleveland Crane and Engineering Co., Wickliffe, Ohio. A new booklet for those interested in the overhead method of materials handling, featuring a variety of grabs and handling devices for many kinds of materials.

Audubon Wire Cloth Corp., Philadelphia, Pa. A folder describing the types of Metalwove Belts and illustrated with pictures showing typical applications of the belts.

Harbison-Walker Refractories Co., Pittsburgh, Pa. A folder on Babosil, a fritted fluxing material to be introduced into the glass batch to impart clarity and luster.

Pangborn Corporation, Hagerstown, Md. Bulletin No. 213, "Pangborn Rotoblast Rocker Barrels." This bulletin describes the operation of cleaning miscellaneous metal items by the airless Rotoblast method.

The B. F. Goodrich Co., Akron, Ohio. A 12 page booklet on cord conveyor belting showing construction details and varied types of operation.

Diamond Iron Works, Inc., Minneapolis, Minn., an 8-page catalog featuring Diamond portable Crushers ranging in size from 9 x 16 to 10 x 24 inches, and a 12-page catalog on Jaw Crushers which are made in ten sizes.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

4 Glasshouse Castings

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- GUNITE A-C
- GUNITE A-CA
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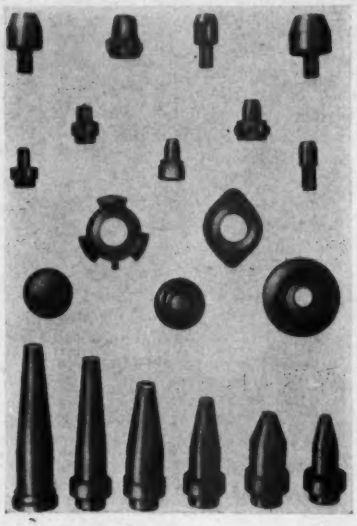

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630 Fifth Avenue (Rockefeller Center) **New York City**

TESTING THE CHEMICAL RESISTANCE OF AMPOULES

(*Continued from page* 19)

out carefully, we put in it methyl red neutral distilled water and seal it. The glass or ampoule to be tested is crushed and sieved on a 0.3 and 0.5 mm. sieve. (American Taylor sieve mesh No. 48 and 32, British IMM sieve No. 36 and 25, DIN 1171 No. 12 and 20). The grains within both sieves are washed thoroughly with alcohol to free them of adhering glass dust and then dried. We add 5 gm. of the prepared grains to a resistant flask containing 100 ml. methyl red neutral distilled water and 0.4 ml. N/100 hydrochloric or sulphuric acid. We heat the flask in a boiling water bath for half an hour, whereby the level of the liquid in the flask should be lower than the level of the bath. The flask is then cooled and back-titrated with N/100 sodium hydroxide solution. The rate of the chemical attack is given by the ml. N/100 acid, which is equivalent to the dissolved alkalies, i.e. 0.40 ml. minus the number of ml. of the back-titrated sodium hydroxide given as ml. N/100 solution. If this number is negative, the glass fails the test. The test solutions are conveniently placed in microburettes.

I tested several ampoule glass tubes and ampoules according to this test and I obtained a clear and accurate view concerning their quality. Thus, this test, which unites the advantages and removes the drawbacks of all tests hitherto prescribed, can be undoubtedly recommended as a general, international test, both by the manufacturer as well as the consumer.

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[1]Pharm. Post, 1907, p. 579.
[2]Z. f. angew. Chemie, 1915, p. 469.
[3]Wiener Klinische Wochenschrift, 1913, p. 406.
[4]Apth. Ztg., 1927, p. 1040.
[5]Pharm. Ztg., 1933, p. 482.
[6]Sprechsaal, 1927, p. 336.
[7]Sprechsaal, 1934, p. 607.
[8]Keram. Rundsch., 1930, p. 387.
[9]Glastechn. Ber., 1930, p. 82.
[10]Apoth. Ztg., 1927, p. 736.
[11]Pharm. Ztg., 1928, p. 777.
[12]Bull. Soc. de Stiinte Farm., 1937, p. 32.
[13]Berger, Geffken and Stösser, Glastechn. Ber., 1935, p. 301; 1936, p. 441.
[14]Bull. Amer. Ceram. Soc., 1934, p. 200.

CHARLES F. TAYLOR DIES

Charles F. Taylor, past chairman of the board of the Chas. Taylor Sons Company, Cincinnati, Ohio, passed away Tuesday, November 26, 1940, at the age of 74. Mr. Taylor was active in the refractory industry since 1880 at which time he joined the Chas. Taylor Sons Company.

GLASS SLICING MACHINES

• We manufacture a variety of wet glass slicing machines for solid glass bars, glass tubing, etc. We can also supply a full line of special glass working machinery for the production of television tubes, incandescent lamps, glass ampules and vials. Glass working lathes and laboratory equipment of all kinds. Cross Fires and Torches. Ask for our catalogue.

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Rejuvenate Your Old LEHR with FIROLL Heating Units

Detail view of FIROLL hollow rolls with burner at one end and air-inspirator exhaust at the other. Fuel is burned in 12 or more hollow rolls, alternate rolls being fired from opposite sides of the lehr. Sting-out at open ends of rolls keeps inside walls hot and provides uniform temperature across the full width of the tunnel.

FIROLL heating units are standard equipment on the well-known FIROLL Annealing Lehr. This lehr also features the unique PAN-WELD conveyor belt which is composed of small sheet-steel units and presents a flat surface to the ware, to eliminate marking and checking.

One of the outstanding annealing jobs of 1940 was performed by a rebuilt plate-glass lehr fitted with new FIROLL heating units. Lehr breakage was practically eliminated, together with losses in the grinding and polishing line. Large stones could even be ground out of the "dead-annealed" sheet with a portable grinder at the end of the lehr.

With FIROLL units such results are possible because the best temperature gradient for the job can be selected and the small FIROLL units can then be located and adjusted to secure and maintain the desired gradient exactly. Either gas or oil may be used.

Toledo engineers will gladly make special recommendations for possible applications of FIROLL units in your present annealing equipment. Write for complete information.

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SOLVAY DUSTLESS DENSE SODA ASH
More than 99.5% Sodium Carbonate *(on a dry basis)*

SOLVAY DUSTLESS CALCINED 98-100% POTASSIUM CARBONATE
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NOTES OMISSION OF MAGNETIC SEPARATORS

Editor, THE GLASS INDUSTRY:

We, naturally, follow with interest all editorial matter in the industrial trade papers and were particularly interested in your very comprehensive flow sheet or sketch depicting the various processes involved in plate glass manufacture, diagrammed by Mr. William Owen.

According to our experience with any firm which deals in cullet in connection with any other processing operation, there is a need of magnetic pulleys or other type of magnetic separating equipment to make sure that the cullet does not contain any iron particles of any kind, due to the fact that such deleterious components have a serious deterring effect on colors. In Mr. Owen's sketch we see no magnetic separating installation at all.

We feel sure that you will have no objection to our calling attention to this omission, as magnetic separation equipment is playing a vital part in the glass manufacturing industry, and we know that your editorial staff constantly strives for accuracy in editorial details.

STEARNS MAGNETIC MFG. CO.
Hugh Sharp

Public Relations Richard Gridley writes THE GLASS INDUSTRY explaining that the magnetic separators were omitted from Mr. Owen's diagram to avoid a congestion he felt would make the chart less readable. Pittsburgh Plate does use magnetic separators, in fact, there are several in every line.—*The Editor.*

CENSUS RELEASES GLASS STATISTICS

The preliminary report of the United States Census for the year 1939 has just been released by the Census Bureau. It places the total value of glass and glassware manufactured in this country at $320,405,252. An additional $37,572,770 is reported for the industry, consisting of laminated glass, stamped and pressed metal products, rubber specialties, and cut and etched glass, which are not items of manufactured glass, but none the less produced in connection with glass-making activities. The $320,405,252 reported by the Government in December compares with $320,000,000 previously reported in the February issue of THE GLASS INDUSTRY, as being the total estimated output of the glass manufacturing industry.

Wage earners were reported by the United States Census at 69,821, comparing with this publication's previously printed estimates of 70,000. Wages for the industry totalled $88,304,912. There are 292 glass factories.

Operations as above described indicate a slight falling away from the peak year of 1937. Dereases are as follows, given in perentages: Number of establishments, 1.3; salaries, 2.9; wage earners, 11.7; wages, 13.1; value of products, 7.7.

The value of glass making machinery during 1939 is placed at $4,300,014, comparing with $4,729,025 in 1937. Incandescent lampmaking machinery showed an increase to $2,623,408, which compares with $2,377,433 in 1937.

FOR SALE
One used EA-4 "Lancaster" Mixer with skip hoist. For particulars write Chas. Taylor Sons Company, Cincinnati, Ohio.

ANTI-MONOPOLY SUIT MARKS TIME

The anti-monopoly suit which the Government is bringing against the glass container industry has been postponed until mid January. At the present time, everything seems to be hinging upon the "Institute" plan which was advanced at the last minute as a compromise that might be acceptable to the Department of Justice. Sharp differences of opinion exist within the industry both as to the desirability and the practicability of this plan, as it is now taking shape under government pressure, and no prediction is warranted as yet to the eventual outcome. During December parties to the suit have been hard at work formulating a Consent Decree. It is reported that several drafts of a Decree have been taken to Washington, and that the defendants feel that every fresh draft is met with new demands by the Government. Events of late January should enable more precise information to be published in the February issue of THE GLASS INDUSTRY.

OPTICAL SOCIEY MEETING

A joint meeting of the Optical Society of America and the American Physical Society will be held in Cambridge, Massachusetts, on Friday and Saturday, February 21 and 22. In addition to sessions for the presentation of contributed papers on Friday afternoon and on Saturday, there will be a joint session with the American Physical Society on Friday morning devoted to the presentation of three invited papers dealing with different aspects of the subject of coler. These invited papers will be profusely illustrated by lantern slides, motion pictures, and lecture-table demonstrations and are intended to provide a broad survey of the advances made during the last decade in the field of color measurement and specification. A joint dinner of the two Societies is being arranged for Friday evening, February 21. The meeting will be open to non-members as well as members of the Society.

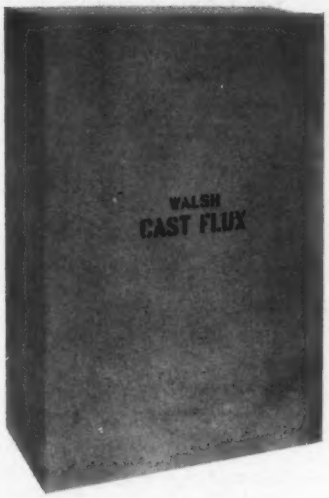
• The Jeannette Glass Company, Jeannette, Pa., will open a branch office in Chicago on January 1 in the Merchandise Mart. The office will carry samples of their full line and be in charge of Mr. D. J. Masters. The E. M. Meder Company, Chicago, were the former representatives of the Company.

• The Brockway Glass Company, Brockway, Pa., is expected to light the fires in the new tank at their Crenshaw factory on January 13. The new factory is practically completed and the latest in equipment for making glass is now being installed.

H. J. ECKENRODE DIES

H. J. Eckenrode, for a number of years was active in the manufacture of plate glass, died in Hollywood, California, on December 22nd. Mr. Eckenrode was a one time associated with the Penn American Plate Glass Company, Alexandria, Indiana, also with Saint Louis Plate Glass Company, Valley Park, Missouri. Later he became Sales Manager for the Edward Ford Plate Glass Company, Rossford, Ohio, and then President of the National Plate Glass Company, a subsidiary of the Fisher Body Corporation.

WALSH CAST-FLUX



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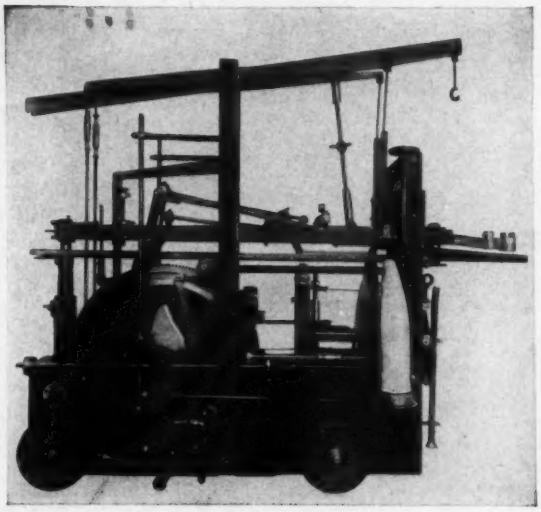
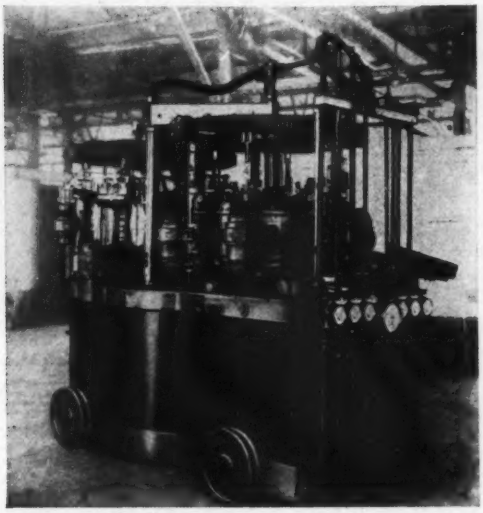


Type "F" single - mould suction machine for the production of small ware

Type "A6" twin table six-arm suction machine for the production of bottles



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